CERTIFIED COPY

BEFORE THE DIVISION OF OIL, GAS AND MINING
DEPARTMENT OF NATURAL RESOURCES
IN AND FOR THE STATE OF UTAH

RECEIVED
MAR 31 1997
DIV. OF OIL, GAS & M

* * *

IN THE MATTER OF THE FIVE- : YEAR PERMIT RENEWAL FOR THE: BEAR CANYON MINE, CO-OP : MINING COMPANY, EMERY : COUNTY, UTAH. :	Cause No. ACT/015/025

* * *

Friday, February 28, 1997, commencing at the hour of 9:40 a.m., a continued hearing was held in the above matter before the Division of Oil, Gas and Mining, at the Emery County Courthouse, Commission Chambers, Castle Dale, Utah.

Reported by:

Scott M. Knight, RPR

APR
Associated Professional Reporters

10 West Broadway, Suite 200 Salt Lake City, UT 84101
(801) 322-3441 / FAX (801) 322-3443

A P P E A R A N C E S

For Co-Op Mining Company:	F. Mark Hansen, Esq., 624 North 300 West, Suite 200 Salt Lake City, Utah 84103
For Water Users:	Jeffrey W. Appel, Esq., APPEL & WARLAUMONT 1100 Boston Building 9 Exchange Place Salt Lake City, Utah 84111
For Water Users:	J. Craig Smith, Esq., NIELSEN & SENIOR Eagle Gate Plaza, Suite 1100 Salt Lake City, Utah 84111
Also Present:	Peter J. Nielsen NIELSEN HYDROGEOLOGIC SERVICES

* * *

I N D E X

I N D E X (Continued)

* * *

PROCEEDINGS

MR. CARTER: Let's go on the record, and we'll start with some preliminary introductory remarks. First, for those of you who are new to this process, this is the third day of the informal conference in the matter of permit renewal for the Bear Canyon Mine, Co-Op Mining Company, Emery County, Utah, Cause No. ACT/015/025.

And I'd like to start out by thanking everyone for making the extraordinary efforts that were necessary to get here today so that we could continue the hearing. This has been difficult to schedule, and I just want to let you know I very much appreciate everyone making their schedules fit so that we could do this. It was looking like we wouldn't be able to get together easily until April sometime. So I'm very pleased that you were able to do that. And thank you. I appreciate that.

We're here, I think, at, essentially, the request of Co-Op. At the close of our last session, I asked the question -- the water users had indicated that they had nothing further to present as a case in chief, if you will -- and I asked Co-Op if Co-Op was interested in presenting information to me as part of the informal conference; they indicated they were, so we're here for that purpose initially, and certainly for any other comments or information people want to submit. But with that, I'll turn it over to Mr. Hansen to tell me what he'd like to do.

MR. HANSEN: We have four witnesses this morning. And I would like to begin by calling Charles Reynolds.

MR. CARTER: All right.

MR. HANSEN: Are we recording?

MR. CARTER: We are. Just for everyone's information, we have a court reporter with us this morning, so we'll take a verbatim transcript as we have in the past several days.

CHARLES REYNOLDS,

called as a witness for and on behalf of Co-Op Mining Company, was examined and testified as follows:

EXAMINATION

BY MR. HANSEN:

Q Would you please give your name for the record.

A My name is Charles Reynolds.

Q Where are you employed?

A I'm employed with Co-Op Mining Company at the Bear Canyon Mine.

Q Is Co-Op Mining Company your employer?

A Yes.

Q That's a change.

A Yeah. I have worked for Mangum Engineering Consultants in the past also, doing -- doing consulting work for Co-Op.

Q And how long did you do the consulting work for Co-Op for Mangum Engineering?

A I've been involved with Co-Op's compliance program since 1991, about June of 1991.

Q Did that include helping to prepare and review the permits?

A Yes, that did.

Q And is that still your responsibility since you've been employed by the Co-Op Mine?

A Yes, it is.

Q Did you review this current permit application?

A Yes.

Q Did your review include the hydrology portion of the permit application?

A Yes, it did, to the extent that -- in evaluating the work that was being done for us by the consultants.

Q Did you evaluate the contents of the permit to determine whether they satisfied the regulations?

A Yes, I did.

Q And do they?

A Yes, they do.

MR. SMITH: I would object to that. I don't know -- that's a legal conclusion.

I've been doing too many trials, Jim. I'm sorry.

MR. HANSEN: This is an informal conference. This witness can testify to his understanding.

MR. SMITH: We'll go ahead and do that with that understanding.

MR. CARTER: Okay. Thank you.

MR. APPEL: It would help if the questions were asked pertaining to his understanding.

MR. CARTER: Well, I'll factor that in those considerations.

MR. HANSEN: You're welcome to cross-examine him.

Q (BY MR. HANSEN) Can you give us a little bit of a background about the mine, the mining operation, and so on?

A Yes. I've been involved with Co-Op's compliance program since 1991. During that time, we've -- we have put together an extensive compliance program to ensure that the mine stays in compliance. This has included weekly inspections of both surface and underground areas to make sure that they remain in compliance. We do have a person employed full-time just in maintaining the compliance issues on the surface. And then I also oversee the compliance for underground to the extent that it -- it involves the SMCRA regulations.

We've -- as we've mined north in the Blind Canyon Seam, we encountered -- the mine was very significantly dry for -- let's see -- about the first eight years of mining. It was in early 1990 when we first began encountering water on the north end, which the -- the other witnesses who follow me will discuss a little bit more of the -- the hydrology involved in that water.

But other than that, both our Blind Canyon Seam and our Tank Seam have been extremely dry mines with very little water encountered, with the exception of the water that comes out of the channel which I mentioned will be discussed further by the other witnesses.

Since that time, we've -- we did obtain a discharge permit, and that mine water discharge is monitored monthly and -- to ensure that that is in compliance with all of the required standards of our permit.

We do have an extensive water monitoring program with the other water -- the other springs, Bear Creek, and water in the mine that we do monitor quarterly. And, in fact, in the case of the two culinary springs, Birch and Big Bear Springs, we were actually taking monthly baseline samples for several years through 1992 and 1993. And we also collected quarterly baseline information on those springs. 1994 and '95, during that time, we've -- during that monitoring we've never observed any impacts to the water quality. We do continue to monitor those springs. They're a part of our regular compliance monitoring program.

Q Have you ever observed the surface conditions at the west fan portal to the mine?

A Yes, I have.

Q Is there any evidence there of discharge out that portal?

A No.

MR. HANSEN: No further questions.

MR. CARTER: Okay. Mr. Appel.

EXAMINATION

BY MR. APPEL:

Q Mr. Reynolds, you indicated that you reviewed and assisted in the preparation of the current permit application?

A Yes.

Q Who assisted you with that?

A The -- assisted by Kim Mangum, who's a licensed professional engineer, and also EarthFax

Engineering as a consultant, doing all the PHC work and the hydrogeologic evaluation of the permit.

Q Okay. Which people at EarthFax did you --

A We were initially assisted by John Garr and Rich White. In the last year, Mr. Garr has left the employment of EarthFax, and Chris Hansen has picked up the work that he would do.

Q Okay. And who was in charge of collecting field data for that effort?

A John Garr collected much of the field data for the PHC. The actual water sampling, I've -- in the past I've done that personally on the other springs, taken regular quarterly samples. And then the -- most of the data for the PHC was collected by EarthFax in the -- the work that was done underground in evaluating the monitor wells, collecting baseline data from those wells and the design and placement of the wells.

Q Was that done by Mr. Garr?

A Mr. Garr and Mr. Rich White.

Q Who did the physical work in the field?

A Mr. Garr did much of the physical work in the field. The wells were also installed by a licensed well driller, Zimmerman Well Service, that did the actual installation work on those.

Q And those are the monitoring wells required by the DOGM in 1991?

A Yes.

Q Are they still functioning?

A Yes, they are.

Q All three of them?

A One of them was in an area that has since been re-treat mine, and that was replaced by a fourth well, one that -- when that well was no longer accessible, we did drill a fourth well to replace that.

Q And they are continuously providing monitoring data?

A Yes, they are.

Q Have they been since 1991?

A The wells were -- the work on the wells were actually completed in 1992 and they've been monitored quarterly for quality data -- let's see -- beginning in 1993. The initial baseline data was taken from them in '92 and they've been monitored continuously since 1993.

Q I think you testified that your involvement began in 1991. Did you have any involvement with the mine operation prior to 1991?

A I don't -- I didn't have any direct involvement. I do maintain, keep track of all the records for the mine, which would include records of what went on prior to that.

Q Okay. You mentioned that the mine was dry for eight years prior to 1990. Is that a correct date?

A Let's see. It was -- I believe it was either in, I think, November of '89 -- November, December of '89 when we first began encountering water on that north end. There was some water there. There were minor roof drippers, fairly small flows ranging from 8 gallon a minute to 40 gallon a minute.

Q And then in late 1989, you encountered noticeably larger flows in the mine?

A Yes. They -- they -- when we initially encountered them, they were flowing -- let's see. I'm just recalling off the top of my head. We do have -- they were flowing around 120 gallon a minute when we first encountered water on the north end near that channel.

Q And there had been next to no flow before that?

A Yes. Let's see. There had been -- there had been -- when we first went in the mine, there was some water flowing near the surface. It varied between 8 and 40 gallon a minute.

Q And am I correct that you keep track of the records concerning water encountered in the mine?

A Yes.

Q Has the mine ever been dry since then?

A No.

Q Has the flow ever gone below 30 gallons per minute in the mine?

A No.

Q What's the lowest flow you've experienced in the mine since 1989?

A Let's see. We did -- it did drop down to around 80 gallon a minute in 1991 and then also again in 1992. This -- this occurred -- well, what happened is, as we'd advance north, as we were approaching that channel, they'd mine for a few months, and because of the quality of the coal, they would have to stop mining in that section and move to another section for a while in order to blend the coal qualities together.

And we did notice that as we pushed forward, as a section would sit, the flows would decrease coming out of the section. And then as we'd continue advancing north, they went up again to a certain extent. And each time we stopped mining, flows would steadily decline.

Q Okay. You were reading from some sort of a chart that indicates in-mine flows?

A Yes.

Q Could you tell us what the -- do you have average flows? I don't know if Mr. Hansen intends to make this an exhibit or not.

DR. MAYO: It will be an exhibit.

MR. APPEL: Okay.

Q (BY MR. APPEL) Tell me what the flows were. You mentioned '92 and '93 low flows. Can you tell me what the low and high flows you encountered were from 1990 through the present?

A Yeah. The low flows were -- we had -- low flow was about 81 gallon a minute in February of '91. Also, in October '92 it measured about 82 gallon a minute. When we initially hit it, it was flowing at 120 gallon a minute. As we advanced northward, it increased up to about 140 gallon a minute the first time, and then the second time it went up to about -- between 170 and 180 gallon a minute.

We did encounter some water initially over on the east side against the fault, near Bear Canyon Fault, which was our point SBC-10. That was encountered in '92. As we -- when we first hit the channel, it initially -- the initial flows that we ran into were about 250 gallon a minute, which immediately dropped off to -- within a couple years it was flowing at about 20 gallon a minute on that side. The significant amount of flow has always been coming from the north channel. Currently, it's flowing at about 125, 130 gallon a minute.

Q When you say "the north channel," what are you referring to?

MR. HANSEN: We'll get into that more with another witness.

THE WITNESS: I'm referring to a geologic channel we've encountered on the north end of our mine which appears to be the source of the majority of the flow coming into the mine. That channel would be characterized and discussed by other witnesses.

Q (BY MR. APPEL) When you were testifying, I believe, on day one of this hearing, you mentioned that there was a period of time during which water was discharged into the old workings for about a year and a half. When did that begin?

A It began in -- at the first of 1990, shortly after we first encountered the water. There was discharge into the old workings of the mine up until we got our -- we were permitted to discharge into Bear Creek at the beginning of 1991, I believe it was. And that was pretty much discontinued -- discharge into the old workings -- at the end of '91 and beginning of '92, at the request of the Division.

Q You mentioned that you had an extensive monitoring program. Could you explain which sources you've monitored and where they're located?

A Yes. We -- we have three surface water monitoring points. One is in Bear Creek above the mine site. The other's in Bear Creek below the mine site. And then we do have a third monitoring point in Right Fork of Bear Canyon above the mine site.

Groundwater monitor points include Birch Spring, Big Bear Spring, and we have a creek well near Bear Creek on the surface. And then we have four monitoring points underground in the Blind Canyon Seam. One is SBC-9, which is where the significant amounts of the flow come in. We also monitor the three monitor wells underground. And we -- at the beginning of this year, we have encountered some minor flows flowing out of our gob that we have begun monitoring as a fifth monitoring point.

Q And how many years have these been utilized, these particular points?

A Birch Spring and Big Bear Spring have been monitored, I believe, since -- 1984 is the oldest data that I have in my files that I've located. The SBC-9 begin monitoring in 1990, when we first encountered that water.

We did have some monitoring points, SBC-7 and SBC-8, which were monitored up till '91 that were the smaller flows near the surface which eventually dried up. They were monitored beginning -- I believe the oldest data, there again, was 1984 that I have on file. And they were monitored through 1990 and 1991, when they dried up.

SBC-9 has been monitored continuously since 1990, and it's still being monitored. Monitor wells underground have been monitored since 1992, which is when they were installed.

Q Are you reading from something that's going to become an exhibit?

A I'm just recalling out of memory. The mine flow data that I was just looking at with SBC-9, I believe the graph will become an exhibit.

Q Okay. Now, I think that in response to Mr. Hansen's question, you said that at least for a time, you've been able to discern no impacts to water quality. Is that a fair statement?

A Yes.

Q Are you also testifying that there have been no impacts to water quantity?

A Yes, there have been -- not been.

Q Ever?

A Yes.

MR. APPEL: That's all I have.

MR. SMITH: I do have a few questions.

EXAMINATION

BY MR. SMITH:

Q Mr. Reynolds, now I just want to understand: You began working with the mine in 1990. Is that the year?

A 1991.

Q Okay. 1991. Did you have any association with the mine before that time?

A No.

Q So when we try to divide between what you may know from learning or what you may know from personal knowledge, your personal knowledge starts in 1991; is that correct?

A That's correct.

Q Now, are you aware of any subsidence around the Bear Canyon Mine?

A Yes, I am.

Q And could you tell me where the subsidence is located?

A We've -- we've had some subsidence holes that have been -- affected the surface in -- on the south end of Blind Canyon Seam. It's in the -- quite high up in the drainage. Let's see. Just east of Blind Canyon. I guess it is a drainage above Birch Spring. That -- that subsidence was repaired and mitigation was provided for in 1994 and 1995. That has since been sealed.

There is also -- we have recently come to my attention there is some subsidence in Blind Canyon that is associated with the old Trail Canyon Mine that, near as we can tell, has been there for -- since prior to SMCRA, been there for some time.

Q Now, is the old Trail Canyon Mine -- is that part of your current permit area?

A That's a separate permit area from the Bear Canyon Mine.

Q Okay. So that's a separate permit area. So let's talk about just the subsidence that you said east of Blind Canyon. That area, is that subsidence?

A Uh-huh (Affirmative).

Q How big of an area are we talking about for subsidence?

A The actual area that was impacted by the surface, it's fairly small area -- it actually consisted of -- there was a hole that came to the surface. It was about 18 feet -- let's see -- about 12 to 18 feet diameter. And then there was also three sinkholes which formed -- one in the bottom of the drainage, and the other is up on the slope -- the slope west of the drainage, which -- all of those were repaired and filled in.

Q So they've been repaired by being filled in.

Is that the repair that was done?

A Yes. And we also restored the drainage channel and the drainage area going to the bottom of the canyon.

Q Any study made of the subsidence areas to see if there was an impact on hydrology, that you're aware of?

A It -- we looked at it some. As far as the impact on the hydrology of subsidence in general, the subsidence of the mine, that has been discussed in PHC and looked at. That particular drainage has always been dry. There are no springs up in that area which would have been impacted by that -- the localized subsidence there.

Q I see. Any study on subsidence associated with the Bear Canyon Mine beyond what we find in the PHC?

A No.

Q So if there's any study that's been done on subsidence, we would find it in the PHC if we looked there --

A Yes.

Q -- is that correct?

A Yes. The PHC does discuss the potential -- the anticipated impacts due to subsidence.

Q And you're not aware of any facts or information or data or expert opinion beyond that that you're going to present today or that Co-Op has --

A No.

Q -- on the issue of subsidence and the hydrology?

A No.

Q You said there was a compliance person for the surface that worked for Co-Op Mine?

A We do have an individual employed doing all the on-site maintenance, making sure ditches stay clean, silt fences are maintained, culverts are kept free, making sure that the drainage devices function correctly.

Q What's that person's name?

A His name's Marlow Petersen.

Q And he worked full-time for Co-Op Mining?

A Yes.

Q Now, getting back to your experience, you said you worked for Mangum -- was it Mangum Engineering?

A Yes.

Q Did you work full-time for Co-Op as an employee of Mangum on Co-Op -- did you work full-time on Co-Op issues when you were employed by Mangum?

A Yes, I did. I've been on the site at the Co-Op Mine full-time since 1991 --

Q I see.

A -- both in the employment of Mangum

Engineering and in the employment of Co-Op Mining.

Q Is there any connection between Mangum Engineering and Co-Op Mining?

A No. They were just hired -- I wasn't hired with Mangum Engineering till 1991. I believe Mangum Engineering was actually employed by Co-Op as a consultant since late 1988, early 1989.

Q Is Mangum still a consultant for Co-Op?

A He does do some consulting work. He does all the reviewing of the engineering work that I do, all the -- the certifying of my work.

Q But Mangum Engineering's completely separate from Co-Op Mining?

A Yes.

Q Not owned by the same entities that own Co-Op Mining?

A That's correct.

Q I take it in your testimony you talked about as you mined north, you began to encounter more water. Was that your testimony?

A Yeah, in our North Main Section.

Q Okay. Was that -- I'm sorry.

A The primary flows came out of the North Main Section. There was -- we also pushed what we call our West Bleeder Section northward that we did not encounter significant flows in.

MR. HANSEN: Can I interrupt just very briefly? Do you intend to be very much longer with Charles? If you are, I'd have to take Dr. Mayo out of order. He's going to be our second witness. He has to be out of here shortly after. He's got to catch a flight this afternoon.

MR. SMITH: I don't think I have -- five to ten minutes is all I have.

MR. HANSEN: Okay.

MR. SMITH: It just seems like a long time.

Q (BY MR. SMITH) Were you surprised by the encountering of the water or was that expected?

A I don't know. I think they were -- they were somewhat surprised. It was -- I personally wasn't there.

Q Okay.

A But the -- I don't know.

MR. CARTER: I can add something to this. When we were looking at the application, it was evident to the Division that the continued mining would move toward what was deemed to be the piezometric surface. So for the Division's perspective, we could see that they were headed toward water --

MR. SMITH: Okay.

MR. CARTER: -- just in general terminology.

This is not cross-examination.

MR. SMITH: That's helpful. That helps me move on.

Q (BY MR. SMITH) You mentioned water you encountered in the mine, correct?

A Yes.

Q And you measure all water that you encounter in the mine or just the water that you discharge out of the mine?

A We measure as best we can the water coming in the mine. What -- the primary way we determine that is by taking the water measurement of the water we discharge as well as the water we use. The actual source of the water is spread over such a large enough area it's really impossible to measure, make sure everything's measured as it's coming in. But we do measure what goes out.

Q Okay. So I understand, you measure the discharge of water?

Is that correct?

A Yes.

Q You need to say yes or no so we get it on our record here.

A Yes.

Q And you measure the water you use in the mine?

A Yes.

Q When you were talking with Mr. Appel about the amount of water, was that a total of those two measurements that you were talking about?

A Yes.

Q What kind of monitoring and metering do you have to measure those records -- measure that water? I'm sorry.

A We've got flow meters on our pipeline.

Q Mr. Appel asked you about the period of time that instead of discharging out of the mine, it was being put into the old workings. Do you recall those questions?

A Yes.

Q And was that water measured?

A My understanding is yes, it was. There was a meter -- I'm not sure how long the meter had been on there when I began working for them, whether there was a meter on that line.

Q Were you working with Co-Op at that time when the water's being pumped into the old workings?

A When I first started working there, there was -- it was at the time that they were still doing that right when I first started there. It was a result of a hearing which was held in 1991 that the Division requested that be discontinued, which it was at that time.

Q Did you notice any impacts on other water sources during the time you were discharging water into the old workings?

A No, we didn't.

Q How about on water coming out other new places around the mine?

A No.

Q Do you know why the Division asked you to quit pumping water into the old workings?

A Some of the -- the employees felt that there may be a potential for water seeping to the surface. And they were concerned with the potential effect on the springs and felt that by discontinuing that, that would eliminate that potential.

Q Yeah. Who felt that way?

A Tom Munson was the hydrologist. As far as specific ways that they felt, I think you'd have to talk to them.

Q These are individuals employed by the Division of Oil, Gas & Mining?

A Yes.

Q No one at Co-Op, I take it?

A That's correct. The request or the -- the request to evaluate that was made by Diane Nielsen. In her division order at that time, her staff felt the best way to make sure -- make sure that there was no potential was to simply eliminate that discharge.

Q Did Co-Op ever do any studies to see if what you've called the potential ever occurred?

A We have -- we have studied and evaluated the data. And I know when the PHC was being generated, then those issues were looked at and discussed in the PHC.

Q So I'd also find those in the PHC?

A That's correct.

Q Any studies since that time?

A No.

Q When was the work that went into the PHC? When was the PHC completed? Do you recall when that was?

A Initially, it was completed in 1993. Either '92 or '93. And it was revised again in -- towards the end of '93, when we submitted our application for mining Tank Seam.

Q Have there been any studies on PHC issues since that time by Co-Op?

A We have done some isotopic evaluation, some additional hydrologic evaluation in preparation for this hearing --

Q I see.

A -- which will be presented by our other witnesses.

Q I guess that's what we'll hear later today?
A That's correct.
MR. SMITH: Okay. That's all I have. Thank you.
MR. HANSEN: I have a few questions, but to accommodate Dr. Mayo's schedule, I would like to reserve them and get Dr. Mayo on now. We would call Dr. Alan Mayo.
MR. APPEL: I'm sorry. Mr. Reynolds, could I ask one more question?
MR. CARTER: Sure.
MR. HANSEN: We'd be happy to call him back.
MR. APPEL: Why don't we call him back, then.
MR. HANSEN: Now or later. I'd just as soon you talk to him later.
MR. SMITH: As long as he's being called later, we'll talk to him then.
MR. CARTER: Don't leave the room, Charles -- or longer than five minutes. Let me put it that way.

ALAN MAYO,

called as a witness for and on behalf of Co-Op Mining Company, was examined and testified as follows:

EXAMINATION

BY MR. HANSEN:

Q Could you give your name for the record?
A My name is Alan Mayo, M-a-y-o.

Q And where are you employed?

A I'm a principal of Mayo & Associates. I'm a professor of hydrogeology at Brigham Young University.

Q Could you describe your educational background?

A I have a bachelor's and master's degrees in geology, a Ph.D. in hydrogeology.

Q Could you briefly describe your work background?

A I've worked for several years as an environmental planner for the County of San Diego; worked for a consulting firm in Georgia; taught at University of Colorado, Colorado Springs, where I started my consulting business; and am now teaching at BYU. I've continued my consulting business since then.

I have -- my business has done considerable work in the coal district. We've worked for Skyline Mine, SUFCO, Soldier Creek -- help me here --

MR. ERIK PETERSEN: Genwal.

THE WITNESS: -- Genwal, Energy West. We're doing work in Colorado. So we have considerable experience working at, understanding, and evaluating hydrogeologic systems in the coal district in Utah.

Q (BY MR. HANSEN) Have you been in these various mines?

A I've been in every one of these mines.

Q Have you been in the Co-Op Mine?

A Visited the Co-Op Mine on November 13th, 1996.

Q Describe for us what you saw at the Co-Op Mine.

A Should I just -- do you want me to take over?

Q It's an open-ended question.

A Okay. Let me start --

Q I would let it be your show rather than mine.

A Okay. On November 13th we made a tour of Co-Op Mine. And Erik Petersen and my staff and myself made the visit of the mine. And we visited inside of both the Blind Canyon Seam and the Tank Seam. We also visited Big Bear Spring and Birch Spring. And we also made a quick trip out the portal that's been discussed at considerable length.

My first observations going into the mine first when we went into the Blind Canyon Seam was that it was an incredibly dry mine. They were not mining in the seam at this time, so there was no dust suppression going on. And fortunately, we were in the front vehicle, not the second vehicle, so we had some visibility.

As we approached the north end of the mine -- if you can use the first graphic here -- so we went in and approached the north end of the mine.

Q Would you point which is north and which is south?

A This is north going in this direction (Indicating).

Q Point out where the entry portal is.

A I believe we came in here and went on up and went in this direction and then went to here, then came back and went over into here (Indicating), okay? So this area in here (Indicating) was just bone dry.

We looked up in the ceiling of the mine to see if there was any evidence -- I look for water having dripped in the mine once the mine has been opened for a while. I wanted telltale signs. You look for pyrite oxidation, the red rust.

Q For a quick break here, is this an accurate depiction of the mine?

A As best as I know.

Q And where did the source data come from?

A This was actually -- actually a graphic that EarthFax put together, so they should be the ones to describe the graphic. But as best as I know, it looks accurate.

MR. HANSEN: I would like to have this admitted as an exhibit. You can do it now or -- I think it'd be easier if we had it marked as an exhibit, we get it in.

MR. CARTER: Let's do that.

MR. REYNOLDS: I might mention, the information pertaining to -- information pertaining to the mine on the map comes from our ventilation map, which is what we submit to MSHA.

MR. CARTER: Is there going to be any difficulty with admitting this or do we need more foundation?

MR. APPEL: What's the purpose for its submission?

THE WITNESS: I'm going to be describing the hydrogeology, and this is going to be one of the exhibits I use to describe that.

MR. APPEL: So it's demonstrative?

THE WITNESS: Yes.

MR. SMITH: I don't have -- I don't have a problem, as long as -- do you have copies of this for us?

MR. HANSEN: I don't know if we have a copy. We can certainly make you one.

MR. SMITH: Yeah, I think --

MR. HANSEN: I don't have copies of your Exhibits 1, 2, 3 either.

MR. SMITH: Well, I'm happy to provide them if you ask, Mark.

MR. HANSEN: I haven't asked. I know.

MR. SMITH: I'd like to have a copy of this. And I think that's typical, to be able to have a copy of exhibits.

MR. HANSEN: Sure. Be happy to provide one.

MR. APPEL: Is that going to be No. 1?

MR. HANSEN: Yes, we mark that Exhibit 1, then.

THE WITNESS: Erik, do you want to do that? Make it look nice.

MR. APPEL: For demonstrative purposes.

MR. CARTER: Sure. When we say --

MR. APPEL: I mean, we're not agreeing to the accuracy of anything on there.

MR. CARTER: I understand.

THE WITNESS: So we entered the mine and made several stops, looking around for signs of water having been in various parts of the mine. When we approached this area right about in here (Indicating), where the lighter blue is, we started seeing roof drips -- not a lot of roof drip but some roof dripping coming on.

Then as we finally got to this area here (Indicating) -- it's called a low coal area -- there was clearly a sandstone seam, a sandstone channel in the roof of the mine. And the channel came down and became -- basically pinched off the coal bed. And in this sandstone channel --

Q (BY MR. HANSEN) It comes down from above, not coming from below?

A From above. As you walk into the area, the channel would be above your head; then it was coming down in this fashion (Indicating).

As we finally reached the channel itself, a considerable amount of water was draining out of the channel. And the first place we looked at it was in this area in here (Indicating). And then subsequently, we came over and looked at it in this area over in -- over in here (Indicating). So large quantities of water were coming out of the channel, but the rest of the area was really exceedingly dry.

We also went over and looked at the fault gouge here (Indicating). And I brought some of it with me, because we went and looked at the Blind Canyon Fault, and rocks -- right, geologists bring rocks. These are chunks of the fault gouge (Indicating). And the gouge itself was dry. It didn't show signs of really having a lot of water on it.

We did some sampling in here. And the sampling that we did -- let's find my second map.

MR. CARTER: Dr. Mayo, about where on the fault would this have come from?

THE WITNESS: It's going to come from right here (Indicating).

Right?

MR. ERIK PETERSEN: Right.

THE WITNESS: Right here (Indicating).

Q (BY MR. HANSEN) We're looking at another exhibit now?

A We're looking at another exhibit.

MR. HANSEN: Could we have this exhibit marked Exhibit 2 for demonstrative purposes?

MR. CARTER: Sure.

THE WITNESS: It's basically the same. It's basically the same map, except it says "3rd West South" on it, so it identifies some sampling locations.

MR. CARTER: All right.

THE WITNESS: It's the same graphic, though, without the coloration for the water on it.

So the fault gouge was in here (Indicating). And we -- we took a look at the fault gouge there and also collected a sample from a drill hole which would have been drilled through the Blind Canyon Seam, and collected water out of that drill hole and analyzed it for carbon 14 and for tritium.

And then there was no water leaking through the fault zone at this point right here (Indicating). But -- and like I say, the fault gouge was quite thick, maybe like this (Indicating), easy to get big chunks of it. You didn't have to use a rock hammer. Pull it off with your hands.

Q Dr. Mayo, the court reporter can't take down this --

A Say 18 inches to 2 feet thick.

MR. CARTER: And orientation of the fault, roughly vertical?

THE WITNESS: Roughly vertical.

We then went to the 3rd West Bleeder area and collected a roof drip sample and analyzed that also for carbon 14 and for tritium. And this was water coming out of the sandstone channel.

Then proceeded down to SBC-9 Source, which is a drill hole drilled into the sandstone channel not quite horizontally inclined. Slightly up. I believe it's slightly up, isn't it? Yeah, slightly up. And sampled that for carbon 14 and for tritium as well.

And then proceeded back to DH-2 and looked at DH-2 and DH-2 was subsequently sampled for carbon 14 and tritium as well. Some development work had to be done to purge the well and that sort of thing.

From there, then we proceeded to the overlying seam, which was also an incredibly dry -- dry seam, and then went out the portal and went and looked at the two springs.

So that kind of summarizes our mine tour. We went on -- what I'd like to do now is to start to show some of the results that -- that we have.

MR. CARTER: Let me ask one question so I can envision this. When you say "a channel," the thing that comes to mind is a channel of limited aerial extent 30 feet across or something like this. What you were describing is, the channel was evident in the north ends of both the western workings and the more easterly workings, so --

THE WITNESS: We envisioned this channel as being an east-west channel that extends the entire length of the open mine area. It's a really large sandstone channel.

MR. CARTER: So its orientation -- the flow, then, would have been east-west --

THE WITNESS: East-west.

MR. CARTER: -- rather than north-south?

THE WITNESS: That's correct.

Okay. A really large sandstone channel with a lot of water in it. In many mines we encounter sandstone channels and they'll have some water in it but not a lot of water. And some of them will drill up to the roof and they'll encounter maybe two or three feet of saturated zone of the channel and the upper part will be dry. But this was a very large channel and it has an awful lot of water in it.

What I'd like to do now is go over some of the results. What we've done here -- this chart (Indicating) summarizes the carbon 14 and tritium analysis that was done in the mine. Part of this data was presented by Peter earlier, and other portions we have collected. The Big Bear Spring, Little Bear Spring, Birch Spring, etc. -- these are data that Peter had presented, and these are essentially out of one of his figures.

Some of the other data -- we've collected carbon 14 on SBC-9 Source, 3rd West South, 3rd West Bleeder, and DH-2. SBC-9 Source is the sandstone channel and it's here (Indicating). It's the drill hole that goes up. 3rd West Bleeder, of course, would be here (Indicating). The 3rd West South is -- goes through the fault, so that's actually collecting water on the other side of the fault zone. Then DH-2 is collecting out of the sandstone beneath the coal seam.

What we find here -- found some really interesting results. We also resampled -- and I believe this is one that Mr. Peter Nielsen had done: 2.2 TU.

Is that correct? Yeah.

We went through and resampled that and sent that to the mining -- tritium laboratory and came up with zero TUs.

MR. HANSEN: Can we get this marked as Exhibit 3? In fact, to avoid confusion, can we have the Co-Op Mine exhibits begin with "C" -- C-1, C-2, C-3?

MR. CARTER: Fine. Let's do that.

THE WITNESS: What we found -- we found some really interesting things. First of all, we found that the water on the west side of the Blind Canyon Fault has a groundwater age somewhere in the neighborhood of 5,000 years. And this is the oldest water that we found in the area. It's considerably older than the water that we find in the sandstone channel and it's considerably older than the water that we find in the sandy horizon beneath the coal seam.

Q (BY MR. HANSEN) Now, this is the water to the west of the fault?

A The -- west of the Blind Canyon Fault, correct.

Q Outside of the area that's being mined?

A That's correct. This is water outside of the area being mined.

We found that the water in the sandstone channel appears to have a groundwater age of somewhere in the neighborhood of 1,500 years. And it's a large volume of water. And when we saw such a large volume of water in a fairly young -- fairly young age, it's pretty clear that some of this water is moving somewhere, because it's not uncommon for us to find in mines water that's ten to twenty thousand years old in some of these overlying sandstone channels.

So this is -- relative to other mines that we find, this is younger water and large volume of water, so the water -- we've got some movement of water, and I'll talk about our analysis on that movement of water.

We find that the water in that overlying sandstone channel has a slightly different age than the water underlying the coal seam, which is about 1,000 years.

Okay. So those are just some raw data that we've come up with in terms -- to help us to start to understand how the system works.

The next thing we did, we wanted to get some idea of flow rates related to the sandstone channel, and so we required from Co-Op their data on discharge related to the sandstone channel. And this hydrograph -- here's the hydrograph of the discharge along that sandstone channel (Indicating). The early part of the hydrograph represents -- we believe represents water which, the associated water, was draining out of the lighter blue area on Exhibit C-1.

And what was our understanding -- and Mr. Reynolds can verify this -- is that they were mining up into this area (Indicating), they were getting increased roof drips out of -- out of the roof. And this area had a little too much ash in it, so they would mine here, take some coal, go blend it with some other coal.

And as they were mining in that area, then they would get increased flows out of it. Then as they would back out, the flow rate would decline. Then they would mine some more into it and the flow would go up. And as they'd back out, the flow rate would decline.

There's water clearly coming out of the roof. And we believe, in all likelihood, the sandstone channel will have the main body of the channel and there will be an overbank area up above which is what you're encountering in the light blue area. So it's really a broad-based channel as well as being a long channel.

On April 27th is when they first mined right up to the portion of the sandstone channel that starts dropping down and pinching off the coal bed. When they encountered that, the flow rate went up substantially. They have mined up to that, and the location's shown on the map on C-1 where the mine working's right up to the channel. Then they haven't done any mining in there for a considerable period of time.

All we see is, the hydrograph of the discharge out of this channel is dropping off. And it looks to us as if that they've already dewatered a substantial amount of the water out of this channel. If we project this hydrograph and let it decline to -- back down to a near-zero drip rate, it probably will not -- I would not want to draw a line at -- a straight line through this data and come down to the zero line because it'll probably approach an asymptotic value. It's the shape of a curve.

Anyway, they've dewatered a substantial amount of water out of this channel. And this water has an age in -- within the neighborhood of, say, 1,500 years.

We wanted to, then, get an idea of "Well, what does all this mean?"

MR. HANSEN: Have we marked this discharge graph as Exhibit C-4?

MR. CARTER: Let's do that.

THE WITNESS: You know, my immediate concern was: Here I've got a really large channel. It's discharging an awful lot of water and the age isn't too terribly old. We've got to have water in this thing that's flowing somewhere. It's part of a flow system. You know, flow system's got a recharge source. It's got a flow path and a discharge. And I get some really old waters in these mines and not much flow. I'm content. We got some there in the Pleistocene and it's sitting around.

But in this one, water's flowing and I wanted to know something about "Well, what could this possibly mean in terms of discharge to the outside world?" if it were. It's not clear to me where this water is actually flowing to. But I wanted to do some calculations to try to understand. Well, let's assume that it's flowing to the outside world instead of flowing along this channel then continuing to stay in the subsurface. So we did some calculations. We've made a little cartoon here.

Made a little cartoon. The width of the channel -- certainly not to scale, but certainly to give us some idea of what this thing might be looking like. This is a map view. Of course, we have the sandstone channel. It has some link. It's bounded by some faults.

It's my view that in this part of the world, the Blind Canyon Fault is really a no-flow -- barrier to flow. So I feel comfortable about that. The length on the other end when it gets to the Bear Canyon Fault, it's likely to have been displaced because the displacement along that fault is so great there are some boundaries to the width of this thing.

MR. CARTER: Can I ask you a question?

THE WITNESS: Sure.

MR. CARTER: The 3rd West South -- that is, the well that sampled water on the west side of the fault -- did you run into hydrostatic head? What I'm asking is, Is the fault an aquiclude in the sense that there's standing water on the west side of the fault under pressure of some sort and you poke through the two feet of gouge and got flow?

THE WITNESS: The drill hole, it's horizontal.

MR. REYNOLDS: It goes --

THE WITNESS: -- slightly up.

MR. REYNOLDS: -- slightly up.

THE WITNESS: So there has to be enough head to let water flow out. But it wasn't like a garden hose. Water is squirting out of this thing.

MR. CARTER: But there was water on the west side and no water on the east side at the point you sampled?

THE WITNESS: Where we sampled, that's correct. And so, you know, I feel pretty confident, at least in that part of the world, the Blind Canyon Fault, where the coal seams are, is not transmitting water. So let me get some idea of what may be happening in terms of the natural flux of water, or flow of water, through this channel area.

And so we did a pretty simple calculation. First, we took and calculated how much water has discharged out of the channel to date. And to date, we have had somewhere in the neighborhood of 9.6×10^8 gallons. A lot of water has come out of the channel.

MR. CARTER: So 9.6×10^8?

THE WITNESS: Yes, which would be nine hundred sixty-eight -- almost a billion gallons of water.

Q (BY MR. HANSEN) Has come out or is in the channel?

A Has discharged.

Q Your calculation shows --

A I'm sorry. Half. Am I doing this wrong? Yes. Half of that. A half a billion gallons of water has discharged out of the channel.

I then looked at this hydrograph and tried to get some idea how much water might be in this channel. And it appears to me that if this hydrograph continues to decline the way it is, it would be a reasonable assumption that approximately half the water has already discharged out of the channel, another half is left to discharge out of the channel.

If that's the case, then I have some idea of how much water the channel held before the mining encountered it. And by doubling that half a million -- half a billion gallons of water to almost a billion gallons of water and dividing it by the mean age of the water, I get a flux rate of water flowing through this channel and discharging out at some location of in the neighborhood of 1.2 gallons per minute.

Now, when you take a large quantity of water and we think of it in terms of the time frame of our own experience -- you know, the leaking toilet or the dripping facet -- you know, that's a short time frame. But when you think of it in terms of 1,500 years and you calculate out the number of minutes that you have, suddenly the flow rates go way down.

And so that's the kind of flux that appears to us is a reasonable number for water to be flowing through this. And that becomes significant because if this water -- the flow of this water would naturally appear to the outer world somewhere, that's the kind of amount -- quantities of water that would be discharging at some spring somewhere. So --

Q At a spring or --

A Wherever. To a creek. Whatever the location.

Q Could it discharge to the surface and simply effloresce?

A It could discharge to the surface. Depending on how it's discharging to the surface, it could go up as evapotranspiration. And I'm not making any claims where this water went. I'm just simply trying to get an idea of the kind of flux that could be going through this channel and to kind of -- you know, that sort of thing.

MR. CARTER: Let me see if I can capsulate this. I think I grasp what you're saying. And I think this relates to Mr. Nielsen's testimony as well, that the age dating of water is not an absolute thing. That doesn't tell you that the water is static just because it's old. As Mr. Nielsen was saying, there were variations and gradations of age that suggest mixing, travel, so forth. You're suggesting that is also the case --

THE WITNESS: Yes.

MR. CARTER: -- and then attempting to attach some numbers to the extent to which that's happening -- the rates and the volumes and so forth?

THE WITNESS: That's correct.

MR. CARTER: And this is helpful to me because I have to confess that earlier on in the process, I was thinking if water were 1,500 years old, it was in place 1,500 years ago and hasn't moved since. Not the case. If the water were 20,000 years old, you might draw that conclusion. But the difference between modern water and 1,500-year-old water and 5,000-year-old water and 20,000-year-old water is significant.

THE WITNESS: It is a significant difference, particularly when you start factoring in volumes of water which may be involved.

MR. HANSEN: Can we mark this as Exhibit C-5 so we don't lose track?

THE WITNESS: Okay. So that's what we have worked up with -- with the -- looking at the isotopic data. So what I'd like to do now is how I envision the flow system inside of the mine and what it might mean. And I would like to talk briefly about the two springs in question and what we've looked at in terms of the two springs in question.

Because the mine -- the roof of the mine is dry and has all appearances of not transmitting substantial quantities of water, and even after it's been opened doesn't have the appearance of transmitting substantial quantities of water until we get in the northern area where this sandstone channel is, I find it difficult to believe that you'd really be getting any appreciable recharge from the overlying bedrock at the surface down through the mine to the underlying formations, because we just don't have any evidence of water vertically flowing through there.

Plus, you have the problem of how do you get water through these coal seams. But just looking in terms of potential water coming through the roof, we don't see any evidence that there really has been any appreciable amount of vertical recharge in that portion of the mine.

I don't see any evidence that there is a hydrologic connection between the various coal seams in the portions of the mine that are completely dry. It appears to me that the Blind Canyon Fault does not transmit water, in other words, acts as a barrier for groundwater which will be in overlying rocks and likely underlying rocks associated with the coal seams. It is likely that the large fault up Bear Canyon is -- also inhibits the flow of groundwater.

So we have a system in here in which we've got some mechanism for recharging at a slow rate, 1.2 gallons a minute. This channel, this east-west channel -- that channel is hydrologically not connected to other hydrologic systems within the mine. And if we look at the ages of the water, we look at the age of the water in DH-2 relative to the age of the water in the overlying channel, the water in the channel really is pretty much older than the water that we find in DH-2.

Okay. So that's kind of the view that I have of what's going on inside of the mine.

We then went and looked at Big Bear Spring. And Big Bear Spring's an interesting spring. It's near the creek. If you were to track -- chase out the contact of the sandstone that Big Bear Spring discharges from and you were to walk that contact out, next thing you know, you're in Bear Creek.

And the rocks that are fractured in that area -- the fracturing of that sandstone -- you know, it's my view that that stream or that creek -- that spring has a pretty good hydrologic connection with the creek. And we'll present some testimony later to talk about the relationship between the hydrograph in that one and the hydrograph of what goes on in the creek. And I will -- I won't touch upon that any more other than my observation is, it looks like you have a really good opportunity for a hydrologic connection in that area and I'm hard-pressed when I go in the mine to find how am I going to be getting these mining activities to be affecting what's going on at Big Bear.

Birch Spring is a water that has some age to it, and it's a water that has -- if I find the right number here -- water that -- it's in the neighborhood of 1,900 years -- a small amount -- it's -- a small amount of tritium, which may or may not indicate that you've got a component of some modern water in this thing.

I don't see that there's a hydrologic connection. And I have a hard time visualizing the hydrologic connection between Birch Spring and where they have actually encountered the large quantity of water in the mine, which is that sandstone channel. And because of the faulting of the Blind Canyon Fault and the -- I just don't quite see how we get this connection, to go from this basically 1,500-year-old water and then go through basically 1,000-year-old water lying beneath that and then have the water discharge out at Birch Spring.

Q (BY MR. HANSEN) Didn't you say this was 5,000-year-old water?

A We've got -- we've got 1,500-year-old water in the channel. We've got 1,000-year-old water in the sandstone that's beneath the channel. And it appears that there's likely a hydrologic disconnect between this channel and that sandstone beneath it. And there will be other testimony that will be presented that will be talking about that sandstone beneath it. I won't go into any detail on that. Those kinds of connections -- we don't really see that evidence that I like to see to make that type of connection.

I won't talk about Birch Spring any more. I'll let others talk about what the -- physically what you see when you go to Birch Spring and some ideas about that.

So that's kind of -- I think that is about all

I really need to say.

MR. CARTER: Okay. Thank you. Questions? Questions?

Mr. Hansen, anything further?

MR. HANSEN: No.

MR. CARTER: All right. Mr. Appel. Mr. Smith.

MR. SMITH: I guess I'll go ahead and ask a few questions first.

EXAMINATION

BY MR. SMITH:

Q You've been retained by Co-Op, as I understand, Dr. Mayo?

A That's correct.

Q And what were you retained specifically to do?

A To help them evaluate the origins and sources of water that they're encountering in the mine and to look at the springs and to help them to understand any relationship that may exist between the hydrogeologic system that we find inside of the mine and the hydrologic systems which are causing the discharge at the two springs.

Q Okay. Now, you did visit the mine?

A Yes.

Q And you spent approximately how long inside the mine?

A Oh, three or four hours.

Q And which parts of the mine did you visit? Did you go through the whole mine? Can we just take a minute and look at the chart? Show us which ones --

A Enters through here (Indicating). I believe we made a turn, went through here (Indicating). Came along here (Indicating), visited the fault, visited the face of the channel, came back and visited in here (Indicating), then went up to the overlying Tank Seam. And I don't think we have a graphic of the Tank Seam. Is it down here? And then visited -- get myself oriented -- I believe we went to about in here, in the Tank Seam (Indicating).

MR. CARTER: May I ask a question? Did the Tank Seam workings extend as far north as the Blind Canyon Seam workings?

MR. REYNOLDS: Not quite, no.

MR. CARTER: But close?

MR. REYNOLDS: Close.

MR. CARTER: Five hundred feet? A thousand feet? I'm sorry.

MR. REYNOLDS: Yeah, there was -- let's see. There's roughly a little over a thousand foot difference.

MR. CARTER: All right.

THE WITNESS: We didn't see evidence of roof drip water coming out the Tank Seam. And it's my understanding -- and others can testify -- that they don't have large discharges out of the Tank Seam.

Q (BY MR. SMITH) Do you know what the discharges are out of the Tank Seam?

A I don't know what it is.

Q Okay. Did you visit this area in the mine in here (Indicating)?

A No. I believe that's closed. Isn't that a gob?

Q No knowledge about this area?

How about this part of the mine (Indicating)?

A Other than we don't have a lot of water flowing out of there.

Q How do you know that?

A Well, because there's no discharge of it. They keep -- I'm assuming that the records that the mine keeps are reasonably accurate records of the amount of water which is discharging out of various portions of the mine.

Q That's a fairly major assumption, isn't that, Dr. Mayo? And let me explain why I think it is: They only measure what they think they use and what they discharge. They don't measure anything else.

A No.

Q Isn't that a pretty big assumption?

A It's my understanding that they measure water that -- let me back up. If it's not discharging out of there, then they wouldn't measure it. And if it's not discharging out of there, then we don't have any evidence of there being water in there.

Q But all they measure -- let me make sure I understand -- make sure you understand my question -- all they measure is what they discharge outside of the mine; is that correct? -- and what they use inside the mine; is that correct?

A Process water and discharge water. That is correct.

Q There are no measurements of any other water?

A You have to understand the water doesn't -- if there's water in a mine, it's either filling up a down-grading end of the mine or it's -- they're using it as process water or it's discharging.

Q Or it's moving into other parts of the mine that maybe aren't being worked?

A Well, at some point, I would assume that if you have any substantial water in there, you would fill that up. I was just in a mine where they had -- where we encountered a fault and suddenly after, this mine was full of water.

Q Okay. Now, also, does water come out with the coal when the coal's mined?

A That's the process water and that's part of the process water they keep track of.

Q How do they measure that water?

A You'll have to ask Mr. Reynolds, and he'll -- he's going to have to give you the details of how they do their actual in-mine --

MR. HANSEN: Mr. Reynolds testified that was already monitored with the flow meter. That was part of his testimony.

Q (BY MR. SMITH) Is there water in the coal seams at all or are they absolutely dry?

A Until we -- until we got to the sandstone channel, the coal was dry. I saw no evidence of water.

Let me tell you what I look for when I go into a mine.

Q Okay.

A I look for water in the roof, any signs of present or past water in the roof. And one good example of water in the roof: You walk in and drips fall on your head. Clearly, something's going on.

I look for signs of pyrite oxidation because if there's much water dripping out of the coal in the roof, all this coal has pyrite in it and some of that will rust and we'll see that.

I then look at the floor. And if they've been

-- they put the powder on the walls of the mines so they prevent fires and explosions and that sort of thing, if -- if you've got water coming out of the floor, you can see a capillary fringe on the bottom of that, or you can see puddles of water.

There's always evidence wherever you go in a mine whether there's water or not. And it's real easy to figure out when you're in a dry part of the mine or in a wet part of the mine.

Q Let's talk about the part of the mine up here (Indicating).

MR. CARTER: That's the north end?

Q (BY MR. SMITH) North end, for the record, that's the wet part of the mine, correct?

A Yes.

Q All your statements about it being dry, they don't apply to that part?

A They don't apply to that part.

Q Is the coal wet in this part of the mine?

A Is there water coming out the coal itself?

Q Is there water in the coal or is the coal dry? That was my question.

A I did not see water coming out of the coal other than where you've got -- you've mined near -- out of the roof, where it's coming through fractures. But out of the ribs, I didn't see water coming out of the ribs out of this. I saw no evidence of the coal itself being an aquifer.

Q And that's based on your visual observations?

A Visual observation, correct. I've seen a lot of coal in my --

Q How long did you spend in this part of the mine, of the three or four hours you were in the whole mine?

A Probably a couple of hours.

Q Two of the four hours were spent in this area (Indicating), in the north end of the mine?

A Yeah, because once you get in there, you start looking around and you start talking, and the next thing you know, you're eating your Snickers for lunch, and it goes on and on.

Q So you would say -- is the coal an aquitard that prevents water from moving through it?

A Yes.

Q Is that true in every mine?

A "Every" is a really strong statement.

Q Every mine that you've been in.

A I know of one mine -- well, let me think. I think we can make the general statement that these coals -- before you come in and mine them and get heaving in the floor and fracturing in the roof, that if you have a thick sequence of coal, that the coal is going to really inhibit the vertical movement of groundwater.

Q Did you look at any of the water meters in the mine?

A I did not.

Q So can you tell me where the meters are, where the water's metered in the mine?

A I don't know where they are.

Q You do know?

A I do not.

Q You do not know where they are?

A I do not know. You have to talk to others to --

Q I just want to ask what you know. We'll get to others later, Dr. Mayo. We'll take our time with you and find out what you know. Believe me, I'll ask the others.

A All of the flow data was data that was provided to me by Co-Op.

Q Did you do anything to verify any of that data?

A I did nothing to verify that data.

Q Did you gather any data yourself?

A I gathered samples for isotopic analysis.

Q And that was on November 13th?

A That is correct.

Q And how many samples did you gather?
A I believe four. Yeah, it's four.
Q Four samples. Can you show on the chart where you gathered each of those four samples?
A DH-2, 3rd West South through the drill hole, the roof drip here (Indicating), and SBC-9 Source.
Q And you took one sample from each of those locations?
A That is correct -- well, it was multiple samples for different kinds of work but basically one collection.
Q And is that all the samples you wanted to take?
A Yes.
Q You didn't feel like you should have taken any more or would have had a better database if you had taken more samples?
A If there had been more roof drips in other places, I would have wanted to have more water. I went and gathered representative samples of those locations.
Q So you took all the samples you felt like you wanted to take?
A Yes. And don't forget, we already had some sampling that Mr. Nielsen had done in other places and we knew we had that data as well. So we added and enlarged the existing database. That was the purpose. That was

the purpose of my sampling.

Q You've been in all the other mines in this area, it sounds like, pretty much?

A Many of them, yes.

Q How would you compare Co-Op's -- let's take the Skyline Mine, for example. You've been in the Skyline Mine?

A Yes.

Q How would you compare Co-Op's Mine, their Bear Canyon Mine here that we're talking about, their water database or water sampling compared to the Skyline Mine? Is it pretty comparable?

A What do you mean? I'm not trying to dodge the question. I need some clarification.

Q I'm happy to clarify my question. I just want to know if the Co-Op Mine and the kind of sampling and wells that it has and the data-collection system that it has is similar to what we find in other mines or better than what we find in other mines or maybe not as good as what we find in other mines in the area. That's why I want to give this a little comparison. We're going to go there.

A On the in-mine, I think it's comparable. You need to understand that the in-mine sampling is not something that is routinely required of any of the mines.

Now, water level measurements and some of the piezometers inside may be required, but in terms of working with the chemistry of these things, that's not something that's required. Chemistry of surface sites -- springs and streams -- that'll be in their mine permit and they'll have a quarterly or semiannually or annually basis on which they have to do that.

So I'd say the Co-Op was pretty much in the same state that other mines that we've been in -- and frankly, we are the ones that have initiated the ideas of doing isotopic work inside of mines and most of the surface of mines. We've really created the large database that now exists throughout the coal district. And yeah, I think it's not fundamentally different.

Q How about outside the mine?

A I haven't looked at other than the two springs.

Q Okay.

A I haven't looked at their hydrographs that we could develop from surface waters. I haven't looked at the chemistries and those kinds of things, so I can't say. I will know -- at least I can reasonably assume that they have a permit which requires them to do monitoring and that permit's been --

Q Let me stop you. If you're making assumptions, I don't want to hear it. I want to hear things you can either know -- you understand you have to testify to your knowledge or give us an opinion that's based on a reasonable degree of scientific certainty?

A This is a reasonable degree of scientific certainty because they have to have a permit; those permits always have to have --

Q I'm going to stop you again.

MR. HANSEN: I object to what Mr. Smith's trying to do.

MR. SMITH: I'm not --

MR. HANSEN: Can I make my objection?

MR. SMITH: Yeah, but don't make a speaking objection. Just make your objection.

MR. HANSEN: I need to describe my objection, sir. I'm entitled to do that. And I'm not required to let you limit what my objection is, okay?

I object to Mr. Smith trying to interpret the law for Mr. Mayo as to what data, what information he is entitled to rely on in forming his expert opinion. That would go to the weight of his opinion, not the admissibility of it.

MR. SMITH: I don't think I did that. I don't know what you're talking about, Mark. But I'll go on. All I'm saying is: Dr. Mayo can give his opinions. He can give his knowledge. When he starts assuming what's in their permit, I think we're wasting our time. I'd like to avoid that kind of testimony.

MR. CARTER: Let me just make an observation for the record and see if people agree. One of the contentions of the water users is that there's insufficient information today in the Division's documents to support the decisions the Division has made to date. That's basically one of the arguments. So I'm just making that observation and acknowledging that's an argument, so I will not react in an overly defensive way.

THE WITNESS: I know I'm not supposed to volunteer, but let me volunteer something and get us out of this: I have not reviewed their surface monitoring plan, so I cannot tell you whether that plan is adequate or not. Does that help you?

Q (BY MR. SMITH) That's helpful. We're just trying to understand, Dr. Mayo, the areas that you know about and the areas you don't know about. We know there are other witnesses and we know we'll have a chance to get to those. But we have you here. I take it you'll be leaving us very soon.

A Yes.

Q We want to just go through the things you know.

Did you visit the three places where test wells were drilled in the mine?

A I only visited DH-2.
Is that right?
MR. ERIK PETERSEN: Uh-huh (Affirmative).
Q (BY MR. SMITH) Is this one right up here (Indicating)?
A I walked up to the well, took a look at it.
Q Did you visit any others?
A I did not.
Q And why not?
A Well, if you go look at a well in a mine, it's just a pipe coming out of the ground. It didn't -- it isn't like you can really gain some great insight from looking at a pipe.
Q Do you know why those wells were drilled?
A I would have to assume.
Q Okay.
A To understand -- to be looking at potentiometric surfaces or potentiometric pressures in underlying water-bearing horizons.
Q And if you were going to design a plan to do that for Co-Op, could you tell us how many wells you would drill inside the mine and where you would locate those wells?
A I haven't thought about that.
Q So you don't have any opinion at all on that?

A I don't have an opinion on that right now. That's right.

Q And so you don't have any opinion on potentiometric surfaces below the mine?

A I have an opinion -- you know, I have looked at the potentiometric data.

Q Well, I think you'd have to answer my question. You say you don't have an opinion on that yet you're relying on that data?

A Well --

Q You've got to give me an opinion on whether you think there's enough data there.

A Well, I didn't -- I don't believe my direct testimony really got into the idea of what those potentiometric surfaces were doing. Did it?

MR. ERIK PETERSEN: That's right.

THE WITNESS: I don't want to be an attorney.

MR. HANSEN: If you want to ask him about that, you can ask him.

MR. CARTER: Find out if he's got an opinion.

Q (BY MR. SMITH) So you have no opinion on the potentiometric surfaces?

A Well, I do have some opinions.

Q Tell what me what your opinion on the potentiometric surfaces is.

A If we could have some of the earlier graphics -- this is the exhibit I want right here (Indicating). This is Exhibit 5.

MR. CARTER: This is the water users' Exhibit 5.

THE WITNESS: Water users' Exhibit 5, yes.

I have some opinions about this graphic. One of them --

Q (BY MR. SMITH) Well, before you get into that, I haven't asked you any opinions about that.

A I thought that's where you were going.

MR. HANSEN: I thought you asked him if he had an opinion about the potentiometric surface and what were those opinions.

Q (BY MR. SMITH) Let me see if I can get us through this a little easier. Do you have an opinion about the potentiometric surface in the Bear Canyon Mine?

A You use the word "surface." And there are several horizons that transmit water, and each of those have a different water level, so there's really going to be, first of all, more than one potentiometric point --

Q Okay.

A -- at any given location. And I think we're operating from the idea here -- which I don't necessarily totally agree with -- is that based on -- I have to think of the best way to describe this --

MR. CARTER: May I interject something?

THE WITNESS: Yes.

MR. CARTER: I don't know if this is helpful or not, but I think there was testimony last time or the very first time that there was a zone of saturation and a surface level of the zone of saturation. And there was a lot of discussion about that surface level of that zone of saturation lying at a point beneath the floor of the mine.

And I don't know, Craig, whether you're headed toward "Is it saturated from there to the center of the earth?" or, you know, how thick -- I'm not sure what's happening. But it seemed to me we were talking about the potentiometric surface being -- or a major one being one that lay beneath the floor of the mine. And where -- I remember where it intercepted the workings, and all those sorts of things.

MR. SMITH: Yeah, that's kind of like where we're heading. That is where we're heading.

THE WITNESS: All right. You have some sandstone layers, and where those sandstone layers are continuous and where there is enough hydraulic conductivity -- horizontal hydraulic conductivity, you can have -- that entire layer may be saturated with water.

Where you're dealing with the coal sequences, we find we don't have this kind of horizontal hydraulic conductivity even just above the coal sequence because you have clays and you have sandstone channels. So when you're in the vicinity of the coal sequences in the Blackhawk, we find really discontinuous bodies of water. And that's what we find everywhere: discontinuous bodies of water. When you get deeper into some of the more continuous sandstones, you can find a more continuous body of water.

Now, the thing that I think would be a mistake to be jumping to is that if you've got a potentiometric surface that implies that all the rock from where you -- that the point where you're measuring the water -- that all the rock above that up to the potentiometric surface is saturated. It doesn't mean that at all. It means there's a pressure point there.

If I'm standing on the downstream side of the dam, the potentiometric surface of the dam of the water is above me and I'm at the low potentiometric point, which means water will run down, but I'm dry. And I think we need to keep that idea clearly in mind, the difference between potential and flow. Potential's the pressure.

Q (BY MR. SMITH) Okay. I think that's helpful.

Let's go back to the chart for a minute. Let me ask you this question, Dr. Mayo: Did you rely on data from the three wells -- or now I guess there's four wells that were drilled inside the mine. Did you rely on that data in the formation of any of your opinions today?

A Not opinions that I presented. The opinions that I presented today were to try to look at -- based on observations that I made where I physically see water in the mine -- whatever we know about the ages of the water, what can I infer about faults, what can I infer about this particular channel that we saw. And those would be the opinions that I really presented today.

Q Okay. Make sure I understand where we're at. There was data taken from those wells about age of water below the coal?

A DH-2.

Q Okay. And I take it the age of the water below the coal helped you to form your opinion? At least you testified to that?

A Yes. It's about 1,000 years old. That's a mean age now, remember. Mean age.

Q Would it have been helpful to have more than one point to have taken that data from throughout the mine to come to the conclusion about the age of water below the coal?

A At that point the mean age is in the

neighborhood of 1,000 years. If we had more points, then we would have more data and -- yes.

Q If you were doing an academic exercise, wouldn't you have gotten more points to help you have a better opinion?

A I viewed this as an academic exercise.

Q Okay.

A When I do science, when I do a project -- this is hard to convince clients at first, is -- I'm going to go in and I'm going to do it, treat this like a science and try to understand the system, and then I'll try to help you understand what it means to whatever your problem is.

Q Okay. Let me put it this way: If you would have had the choice of picking any points of taking water for age testing below the coal, would you have just picked one?

A I just picked one.

Q Would you have just picked one, though, if you had had that opportunity, just take it from anywhere?

A I made those decisions.

Q So it's your opinion -- and I want to make sure we understand this -- that one point is sufficient --

A This --

Q -- to form your conclusion?

A -- this one point is sufficient to help me relate what's going on beneath the coal here and the area where we have water. And that's where I was looking at, trying to understand those relationships, because you remember what I was doing was not a full-blown characterization of this system; it's more of a limited --

Q Well, tell me how limited your opinion is.

A Well, I think I made direct testimony as to what -- to what I think -- what my opinions are and what the direct data and -- and what my calculations are. I think they were pretty clear.

Q Is it possible, Dr. Mayo, the age of water -- say we picked a point right here (Indicating) below the coal, than a point right here (Indicating).

A Yes.

Q What about right here (Indicating)? Could it be different age right here?

A Yes.

Q You just don't know?

A Well, I think the way you say "You just don't know" is -- when you're dating water, what you're getting is the collection of all those water molecules that recharge at different times under different -- whatever the mechanisms are, they all come together and we've got this chunk of water. And we're not dating a single molecule, so you can have slight differences that are going on.

It's like when you presented -- came down here and you collected Bear Spring at one point. We could make the same argument that maybe you should have been sampling Bear Spring every month and doing carbon 14 and tritium on it for every month for five years and then we should have this area --

Q All I want to make clear, Dr. Mayo, is, you said the age of the water under the coal is a certain age.

A At that point.

Q And your testimony, was not limited to that, as I recall. You said the age of the water under the coal -- there was not any limitation in your testimony, Dr. Mayo. And you infer -- at least I infer from your testimony you were talking about the whole mine. Now we find out it's taken from one sample point.

A It's taken from one sample point.

Q And you don't know what the age is at other points under the mine?

A That is correct.

Q Thank you.

I want to try to understand a little bit better about this sandstone channel we've been talking about. I'm not a geologist. I'm not a hydrologist. How big is this sandstone channel that we're talking about?

A I don't know. I believe the length of it is going to basically run from the Blind Canyon Fault to the big bounding fault on the east side. Its width I don't understand, and I don't understand what its depth is. I've seen the bottom of it, portions of the bottom of it, so I know that it's clearly a channel. You see this thing coming down like this (Indicating).

Q Can you point out the boundaries of it on this exhibit? I believe this is Exhibit 1. Can you point out the boundaries?

A I have seen the channel here and I have seen the channel here (Indicating). And I believe someone else will present testimony that they've seen the channel here (Indicating).

Is that true or not?

MR. REYNOLDS: We never quite hit that channel.

THE WITNESS: Never quite hit the channel there.

Q (BY MR. SMITH) You show a boundary on here. This is similar to some of the questions you asked Mr. Nielsen about boundaries and coals, so I guess you understand what I'm getting at.

A Absolutely.

Q Do you know that this boundary exists here (Indicating)? Is that just a guess?

A That's a fault and I've seen it in -- right here (Indicating).

Q Okay.

A So I physically have seen it right here (Indicating).

Q And you believe the fault is a boundary for the channel?

A In this part of the world, where -- yes. And that's based on ages of water I get on the one side and the age of the water in the sandstone channel itself, and also looking at the fault gouge itself.

And do not take Exhibit 1-C as being necessarily a true and accurate depiction of where these channels are. When you look at the channels, this is -- in class I call it a cartoon, but here I'll call it a diagram, illustrating it for illustrative purposes what we think is going on.

Q Okay. And so there's another fault along this edge here (Indicating)?

A The Bear Canyon Fault runs -- am I correct? -- down in here, down in here (Indicating), and runs --

Q So the channel can continue down here (Indicating)? You just don't know?

A That is correct. And I did not use this in an area calculation, okay? I did not try to approach the problem of how much water flux may be going through this on the basis of an area calculation because I don't have enough data on the area of the channel.

Q Tell me what sorts of testing you could do that would be helpful -- testing or data collection that would help you to better understand this channel.

MR. CARTER: Drill 50 holes in it.

THE WITNESS: If we knew the geometry of the channel, that would be extremely helpful. That would help you define the volume of the rock. Then you -- I understand something about porosity of the rock and get some idea of what the specific retention of the rock will be. Then we can get a better idea of the volume of water that's in this thing.

MR. HANSEN: I suppose someone could go in and mine out the entire thing and you'd know exactly what it was.

MR. SMITH: Mark, come on. Are you going to -- well --

MR. HANSEN: This is informal.

MR. SMITH: Well, I know it's informal.

MR. CARTER: Let me make an observation. I have geology in my background as well. So the way -- I think I understand that Dr. Mayo would not testify that based on observation points he would verify that there is no possibility that something else could be happening. But I understand his testimony to be that "I looked at these six pieces of information and then tried to make them fit in some sort of coherent puzzle."

And to answer your question, I said facetiously, "50 drills holes." That's what all geologists want is a well density of about ten meters so you got the thing drilled like Swiss cheese. Then you know exactly what you got and where it is. And I understand the argument that the water users are making. They're saying, "This is too skeletal to be able to draw the conclusion that you did." But also, I don't believe that I understood Dr. Mayo to say he's verifying the exact configuration of the channel and so forth. He's saying, "Here's my theory based on what I'm observing."

THE WITNESS: I wish I'd said that.

MR. SMITH: Thanks Jim. That's helpful.

MR. HANSEN: Incorporated my reference.

Q (BY MR. SMITH) I'm trying to understand the channel in a 3-D way. Do you know how deep it goes, or we don't know?

A I don't know how deep it goes. There's literature on what a lot of these channels look like.

And we've looked at the literature, but I don't know what -- the geometry of this. But I feel fairly comfortable the thing has got some length to it and I feel fairly comfortable what its orientation is, but in terms of the rest of the geometry of the channel, I don't understand it.

Q Okay. That's helpful to know.

Now, do you know where the channel is being recharged --

A I don't know.

Q -- from?

A I believe my direct testimony -- I said I don't know where it's being recharged from and I don't know where it's discharging. But I -- based on the data we have, I feel that we have an idea what the flux through the channel is.

Q But water is moving --

A Oh, absolutely.

Q -- through the channel?

So you believe it is discharging somewhat?

A It's flowing somewhere. And that by reference, that means ultimately it has to discharge somewhere, right. There is no giant sink, no black hole for groundwater out here.

MR. CARTER: It's going somewhere.

THE WITNESS: It comes out somewhere.

Q (BY MR. SMITH) And it's recharging somewhere. We just don't know?

A That's correct.

Q When you talked about the mines being dry, you're talking about this area of the mine (Indicating), not the area in blue?

A That is correct.

Q And you wouldn't have the same testimony for the so-called wet area of the mine?

A No, that -- you walk in there and water will fall on your head.

Q How would you compare the wet area of the mine to other mines you've been in in this area?

A In the light blue, fairly comfortable. Where we hit the sandstone channel itself, I've seen those kinds of flows in a couple of other mines. You know, they're localized, though. When you find any large discharge, it's typically localized.

And you've heard testimony -- and I'll collaborate that -- that what happens normally is, you'll be mining along. There will be some water in some of the sands above you, but the water drains out because it's not a very thick saturated sequence. It drains out. Then it becomes dry. And that's -- you know, I think this mine pretty much fits that pattern until you run into this big channel. And I think that channel itself is being dewatered right now as we speak.

MR. CARTER: Let me ask a question. One of the concepts -- my own concept, at least, here was that the water in the north end of the mine was coming from the floor or from the working face. It's now clear that the water is coming from above --

THE WITNESS: From above.

MR. CARTER: -- at that point of the mine.

THE WITNESS: If I could draw a cartoon here --

MR. SMITH: Go ahead. I'm going to sit down and look at my notes; so you go ahead and draw a cartoon.

THE WITNESS: If we were to do a north-south cross section of the channel, if we start right in here somewhere (Indicating), here's the roof of the mine going like this (Indicating); then you come down to where the channel is and it kind of truncates like this (Indicating).

I think what's going on, we've got this channel here and we've got this kind of overbank area of the channel, something like this (Indicating). Am I doing okay? And so when they hit the -- you hit the smaller amount of water, you're at -- I'm not sure what the thickness of this thing is -- but you're in this part of it (Indicating), you know, and when you get into where the bigger quantity of it -- you're in the thicker part of the channel.

So I think we're looking at one of the edges of this big stream of some sort with smaller overbank flow going off to the south end. And when you run out of water, I think we're pretty much out of that overbank flow area. But I don't know what the rest of the geometry of this thing looks like.

MR. CARTER: These are custom coals, right? I mean, this is a stream delta --

THE WITNESS: That's right.

MR. CARTER: -- into a lake? Freshwater? Saltwater? An ocean?

Q (BY MR. SMITH) Okay. Let me move on. I want to ask you a question about Exhibit 3, if you want to look at that, Dr. Mayo. As I've said before, and I'll say many times during the course of this hearing, I'm no geologist, no hydrologist, but if I look at the age of the water here for your various tests, it appears to me that Birch Spring is very similar in age to what you call the channel water.

A Yes, uh-huh (Affirmative).

Q Can you draw any inferences from that similar age or not?

A Well, if you want to have -- and I forget what the discharge out of Birch Spring is -- you're going to have to have a pretty incredible conduit to get that quantity of water out to Birch Spring that rapidly.

MR. CARTER: Is Birch Spring west of the Blind Canyon Fault or on the fault?

Q (BY MR. SMITH) Yeah, can you point out where Birch Spring is on that map, Dr. Mayo? That may be helpful.

THE WITNESS: I'm not sure it shows up on that map.

MR. HANSEN: It's quite a bit west. Eight hundred feet west.

MR. CARTER: So it would be off that map to the top, right?

MR. NIELSEN: The top corner.

Q (BY MR. SMITH) So it would be like in this area right in here (Indicating)? You know, I'm just wondering if Birch Spring intercepts the same channel water from another part of the channel.

A Well, at least where we see the water in the channel, I don't think that the fault is transmitting water across it. And I think you look at the age of the water just on the other side of it, I think that's what's going on. When we go further to the south, I don't know -- I don't know how the fault would behave there in terms of barrier/nonbarrier, because I just don't have any data.

MR. CARTER: Craig, I understand your question to be, Could the Birch Spring water be channel water maybe from that portion of the channel on the west side of the fault even --

MR. SMITH: Uh-huh (Affirmative).

MR. CARTER: -- whether or not it's crossing the fault?

THE WITNESS: If we did that kind of calculation, though, and we did the calculation looking at fluxes of water versus age of water, we'd run out of water really fast if Birch Spring was what was draining -- was being fed by that channel, because the channel -- the hydrograph looks like we're dewatering the channel. So Birch Spring should have dewatered it a long time ago because it's discharging a lot greater rate than 1.2 gallons a minute.

Q (BY MR. SMITH) That gets to my next question. Exhibit 4 is the discharge from the channel, and you say it's going down, but it seems to have gone up and down. And actually, the last measurement looks fairly steady. The last five measurements are fairly steady. Maybe we've hit a steady state.

A You also had another period in there where it appears to have hit steady state and gone up. If you look at this hydrograph in its totality, we did decline on it, and in another year we'll have more data on it and I believe that you can see this thing is declining.

There's also -- Charles -- Mr. Reynolds is going to have to testify about, you know, how they do their measurements and those kinds of things. And there's always a certain amount of plus or minus values when you're doing a measurement. And these are --

Q Well, as I understand your chart, the line on here above the year '93, that's when you say --

A Actually exposed the bare part of the channel, yes.

Q And then right after they expose it, it dropped down?

A Well, remember, they encountered it in two different times. And Mr. Reynolds will have to testify exactly how their mining related to this. But, you know, they drove tunnels into the channel at two different times and I don't believe those were simultaneous. I'd be surprised if they are. But Mr. Reynolds will have to testify about that.

Q Okay. It's been up and down but they were also encountering a fair amount of water before they hit the channel. What water is that?

A That would be the water that is in the light blue area here (Indicating).

Q Is that water shown on your Exhibit 3?

A Which is -- yes, that would be before the line -- oh, no, that would be -- let's see.

Q I'm trying to correlate your exhibits and Exhibit 3 to Exhibit 4.

A Where was our --

MR. ERIK PETERSEN: I'm lost here. Which exhibit are we after?

MR. CARTER: Exhibit 3 is the chemistry.

MR. HANSEN: The diagram that Mr. Mayo is holding in his hand is Exhibit 1. The one that is posted on the clipboard is Exhibit 2.

THE WITNESS: Which one is -- is it going to be --

MR. HANSEN: And Exhibit 2 is basically Exhibit 1 without the blue coloration. Is that clarified?

MR. SMITH: That's fine. I guess my question to Dr. Mayo --

THE WITNESS: We don't really have -- I don't have a sample from that because both of our -- of our sandstones in the channel were from the main body or -- from the main body or near the main body of the channel. One was a drill hole that went up into it and the other was on the face of it.

Q (BY MR. SMITH) What was -- I'll call it the prechannel water, just for identification -- what was the relationship of the prechannel water to the channel water?

A I would think it's part of the same hydrologic system. That's the assumption that I'm going to make here.

Q I see. And do we know the age of the prechannel water --

A No. I think we just covered that. Don't have a good sample because a lot of that drainage, remember, already went on before we --

MR. HANSEN: Is that area pretty well dewatered now?

THE WITNESS: Yeah. There are some drips. There are not enormous flows coming out of it. There are some drips that one encounters. And others would have to testify about, you know, the decline of those as you look at the drips.

MR. HANSEN: So there really isn't any water in that area to sample at this point; is that accurate?

THE WITNESS: Well, as you get closer to the main body of the channel, then more drips start to occur, but there were no really good flows coming out of it.

Q (BY MR. SMITH) But you could have found enough water to sample. We're just talking about a bottle of water.

A I'm not sure I could have gotten a good sample for tritium analysis, if that's your question, because tritium -- you've got to be careful with tritium because you've got the atmosphere in small drips, and lots of bad things can happen to your analysis -- to your sample.

Q Did you try to take a sample of what I'm calling the prechannel water?

A No.

Q And you didn't look to take one? I mean, you weren't looking for a source to take that?

A If there had been a really good source of water, I would have grabbed it.

Q At least in the parts of the mine that you went into?

A That's correct. I'm not in the business -- well, never mind. We try to get data is what we try to get.

Q You know, if you read -- and I'm sure you know these much better than I do -- there's been a number of USGS studies -- and I don't know if we'll go through some of those, but there's been a number of USGS studies done on coal mining and aquifers and things, and they always talk about the regional aquifer.

A And they're wrong. I'm going to make a statement right here: They're wrong.

Q Explain to us how they're wrong.

A There's been a lot of discussion in some of the literature about regional aquifers and Price River Formation, for example. Go try to find one. You can't find any. Some of these formations will carry water really well and others will not carry water really well. The Flagstaff will carry water.

There's commonly discharge of springs at the contact between the North Horn and the Price River. It's very difficult to find many springs in the Blackhawk Formation -- very difficult. And the reason is, the Blackhawk Formation doesn't transmit a lot of water. Ages of water in the Blackhawk, particularly when you get away from a mine face commonly go up -- very large numbers: ten, twelve thousand years. When you get into the sandstone beneath the Blackhawk, you commonly can find quite a bit of water in it. So the idea of these big regional aquifers, it's just not a true concept.

And we're in the process now of doing a big study on a regionwide basis and at some point in the not-too-distant future, we're going to be describing what we think is going on with these systems. Some of them will carry water; some will not carry water. But the idea you got to saturate a thickness from the top of the hill down to the Mancos Shale is simply wrong.

Q Did you do any effort to identify what water that was coming out of -- let's take Birch Spring, for example -- where Birch Springs -- the water is discharging out of Birch Spring, where that's coming from?

A No.

Q How about Big Bear Spring?

A Big Bear Spring was a lot more -- I don't want to use the word "obvious." If you look at it, it is a pretty clear geologic explanation for Big Bear Spring. You map out where -- you walk over to the spring and you look at where the rocks are and you follow the contact of the outcrop and you walk up and you walk into the creek. And then you look at the fracturing on this guy. And it would be really easy for water to get out of that creek and to flow through these fractures and discharge into the spring. And then you look at the carbon 14 data and the tritium data. And this guy, just from those perspectives, clearly has a lot of water in it -- lots and lots of water -- so much that if there is a contribution from older water sources, it's mass.

Q I think I have just a couple more questions. Oh. When you call the sandstone channel -- would you characterize that as a perched aquifer? Is that how you would characterize that? I want to try to fit it in with some of the other literature I've been reading in my spare moments.

A Yeah, I think in the context of the literature that you've been reading, I think "perched" would probably be the way to describe that.

Q Okay. And when you say the water's moving through the channel -- which directions? Do you know which directions? Is it moving vertically or horizontally or both?

A Horizontally.

Q Is it also moving vertically as well?

A Well, now it is, out the bottom, moving horizontally in a major way. I don't believe that those coal seams prior to this would allow it to be moving much -- to be moving vertically. And then if we look at the calculations I did on flux, you can't have a lot of water moving through this thing at all.

Q Except through -- I guess, if there were faults and fractures in the coal seams?

A We're still down to -- what is this? A one-gallon bucket?

MR. HANSEN: Looks like it.

THE WITNESS: A couple of these a year -- a couple of those a minute.

Q (BY MR. SMITH) Of water moving vertically? Is that what you're saying?

MR. HANSEN: Totally.

THE WITNESS: Total water.

Q (BY MR. SMITH) I'm sorry. I'm lost.

A Total water. Total water flowing through it by whatever mechanism you want. And if you look at rocks in general, if you look at the vertical versus the horizontal hydraulic conductivity, unless there's some big fault, some vertical avenue where you get increased vertical hydraulic conductivity, the horizontal is -- in almost every sedimentary rock is going to be substantially greater than the vertical, orders of magnitude difference in hydraulic conductivity. And that's really what's going to control the flow of water. And horizontal doesn't mean tangentially to the surface of the earth. It's going to move parallel to whatever the structures are.

MR. CARTER: Just for my own understanding as much as for anything, the way to say this would be that the water that's in the channel is not 20,000-year-old isolated water that was laid down --

THE WITNESS: At the end of the last glaciation.

MR. CARTER: -- a long time ago. There is flow in there?

THE WITNESS: Yes.

MR. CARTER: But that the age of the water and the projected, basically, decline curve that you would project based on what's been discharged and what you anticipate the discharge to be would suggest to you it's only moving at the rate of a gallon or two a minute, that the rate is very slow?

THE WITNESS: Yes.

MR. CARTER: It's not absolutely static?

THE WITNESS: That's right.

MR. CARTER: It's not moderate either?

THE WITNESS: That's right.

Q (BY MR. SMITH) You said that it was likely the faults inhibit the flow in the channel. Can you give me a little more detail on that?

A Well, where we looked at the fault, at the Blind Canyon Fault, on the one side of the fault we've got water which is 5,000 years old. On the other side in the channel I had younger water. I looked at the fault gouge itself, brought back a few pieces. The fault gouge shows -- was dry. There wasn't water coming up out of the floor, out of the roof opposite the fault gouge. It was a dry fault zone.

So in that part of the world it looked as if the faulting has caused a substantial amount of gouge. And that gouge may be -- it appears to be playing a role. It could be something else on the other side of the fault that is causing this as well, but at least we do have no evidence of water coming across that and we have a lot of gouge.

Then you go to the big bounding fault on the east side. It's got several hundred feet of displacement. And I haven't encountered that inside of the mine, so I can't give you any direct testimony on it other than it's got an awful lot of displacement on it, which is going -- to get water to flow across it, you're going to, one, not have a fault gouge like this that's going to prevent flow; and secondly, you're going to have to get two rock units opposite each other that have high enough hydraulic conductivity so water can flow through it.

In my experience looking at -- when you go inside a mine, once in a while we'll find water associated with a fault but it's not flowing through the gouge itself; it's flowing on one side or the other. The gouge is soft -- I mean, if you have water flowing through the gouge, it dissolves.

Q Okay. Were you asked to look at the decline of flow of Birch or Big Bear Spring?

A I did not analyze that. I mean, I looked at it but I didn't analyze it from the perspective of presenting any testimony.

Q So you have no testimony to present on why those springs are producing less water now than they were a few years ago?

A No. I'll let others do that.

Q That was just outside the scope of your responsibility?

A Yes.

Q That's outside of what you were asked to do.

Is any of the information that you presented -- is that found in the PHC?

A I don't believe so. Well, I'm not sure. Maybe some of the things about the sandstone channel and dripping out of the sandstone channel, that sort of thing. But the isotopic information is not in the PHC. And it's not in most PHCs, except for mine.

Q Except for the ones you do?

MR. CARTER: I'm making notes here.

MR. ERIK PETERSEN: This is an advertisement.

THE WITNESS: That was a blatant advertisement.

Q (BY MR. SMITH) Can you tell me whether the conclusions of the PHC conform to your conclusions or not?

A No, I cannot.

Q You cannot say whether they do or not?
A I haven't reviewed the PHC in terms of "Is this PHC adequate?" and that sort of thing.
Q That's been outside the scope of --
A Right.
MR. SMITH: I think that's all the questions I have. I'm sure Mr. Appel has a couple of questions.

EXAMINATION

BY MR. APPEL:

Q Have a seat, Dr. Mayo. Take a load off your feet.
A I don't mind.
Q I do mind. I know you're used to standing and talking to your students, but we're not your students.
Okay. Looking at Exhibit C-4, you've drawn a delineation of mining up to the sandstone channel. Are you with me?
A I'm with you. That's the hydrograph.
Q There are still some fairly significant flows prior to mining up to the sandstone channel, correct?
A Yes. Yes.
Q And you're aware of Mr. Reynolds' testimony that the mine was dry for eight years then suddenly they began to encounter water?
A Yes.

Q Isn't it likely that at the point where they began to encounter water they were intercepting a leading edge of the potentiometric surface?

MR. HANSEN: What potentiometric surface?

MR. APPEL: See if he can answer the question.

THE WITNESS: I don't think so.

Q (BY MR. APPEL) Why not?

A Because this water is coming out of a sandstone channel out of the roof.

Q Which water?

A The water that is in this hydrograph, C-4. That water's coming out of the roof. And the potentiometric surface that you're referring to would be water which would be in underlying sandstones beneath the coal.

Q Now. I'm talking about then. Can't the potentiometric surface be changed by the interception of water? Can't the leading edge be moved back?

A Yeah, I think we'll have testimony that will discuss that very issue in considerable depth.

Q Well, let me ask you what you think.

A I don't have an opinion on that.

Q Okay. Do you think that the water intercepted before the sandstone channel was isolated relic water or is it part of the hydrologic flow regime in this area that supports the potentiometric surface?

MR. HANSEN: I'm going to object. The question's vague and ambiguous. When I tried to bring that out before, I don't think I succeeded very well. Mr. Appel is talking about a potentiometric surface. In that context, I have no idea what he's talking about.

MR. APPEL: But I think Dr. Mayo may. I'm not certain I have to satisfy your expectations.

MR. HANSEN: I think we have to have something to let your question be clear enough that somebody other than yourself and Dr. Mayo knows what's going on here.

Q (BY MR. APPEL) Even after coaching by your counsel, you understand what I'm asking you.

A I lost the question.

MR. HANSEN: I'd like Mr. Carter to rule on my objection.

MR. CARTER: I think I need to say something that would clarify something I said earlier, a sort of interjection, that was at the time that -- there was a time -- and I can't give you the specific dates -- I'd have to look at the file -- the Division was aware, based on the drilling of the test wells and the sampling of the test wells, that there was a potentiometric surface that the experts for Co-Op mapped as being below the active workings of the Blind Canyon Seam, but that they projected that continued northward mining would, at some point, intercept that surface as they projected it based upon the drill data they had available to them.

So when I said we knew Co-Op was mining toward water, it was a very general statement that you could just project two straight lines and see an intersection of this potentiometric surface which lay beneath the coal seam that they were in and the direction they were mining would intersect at some point to the north.

So that's, you know, a very generalized -- there was not -- the information with regard to the channel and all those sorts of things was not in the hands of the Division at the time, saying, "Oh, yeah, we knew they were mining toward water." But I wanted to say that in order to clarify what I had said earlier, especially in light of what Dr. Mayo is testifying here to.

So the Division did not think there were -- well, never mind. I've said what I wanted to say on that. In terms of -- I'm not sure I understand your objection exactly, but I was trying to --

MR. HANSEN: Maybe if I can clarify: We've heard testimony in this proceeding, and also in previous proceedings, that was conflicting. Some testimony given by the water users was that there was a single aquifer with a single potentiometric surface, one straight line table?

A Well, it gets back to the thing about the USGS. It has not encountered water that's in the underlying sandstones.

Q The water under the mine?

A Under the mine. It has not encountered that water.

Q But has it encountered water that has been recharged from the surface?

A Yes.

Q So --

MR. CARTER: Thank you all.

MR. HANSEN: Glad we cleared that up.

Q (BY MR. APPEL) So it's water recharged from the surface that would make its way down until it encountered something that would prohibit it from moving down?

A Yes.

Q And then it would move out or somewhere?

A Yes.

Q Okay. So as the mining moves back into the hill, for lack of a better term -- mountain -- I guess it's a mountain -- it is encountering water that could support recharge down farther in the stratigraphy because of faults and fractures, correct?

A In a theoretical sense, yes. But in a practical sense in this case, I don't think it's supporting appreciable, if any, downward flow from the bottom of the sandstone channel.

Q We're talking about before we get to the sandstone channel now.

A I don't know what the mechanism is for this water getting in. I mean, it clearly has moved somehow to get into this channel. As you get closer to the edge of the --

Q Forget the channel. We're not there yet.

A Okay.

Q Appreciable flows have been encountered in mining beginning in 1990, as Mr. Reynolds testified, a significant difference. Now, under your model, was that water recharged from the surface?

A Yes.

Q Okay. Can we call that a leading edge of recharged water? Is that a term you could be conversant with?

A I'm conversant with it but I wouldn't apply that to this.

Q You don't like using the term "potentiometric surface." I would have called it the leading edge of the potentiometric surface. Would you be conversant with that?

A You're really mixing things up now.

Q Let's leave "potentiometric surface" alone. The recharge from the surface would support the groundwater table you would see throughout the sequence, correct?

A Recharge from the surface supports all the groundwater that we find from the top of the hill anywhere to the Mancos Shale or even below, yes.

Q And how would you account for the difference between no flow in the 1980s mining and the substantial flows that we've seen even before the sandstone channel was encountered?

A They started hitting the edge of the sandstone channel because, as I drew the cartoon, it's a big fat channel with an overbank flow area. And when they started mining into that, they started getting water, and that's where their first water was encountered.

Q How wide is the sandstone channel?

A I don't know.

Q How deep and thick is it?

A I don't know.

Q This particular exhibit says that they encountered that water before they mined up to the sandstone channel.

A But they --

MR. CARTER: I think I understand the concept. I mean -- well, I won't put words in your mouth. My understanding of your testimony was, all this water that Co-Op has seen coming out of this roof, or the great majority of it, is coming from the channel --

THE WITNESS: That's right.

MR. CARTER: -- from the system.

THE WITNESS: A main body of the channel --

MR. CARTER: But until 1993 it didn't hit the sand and see it.

THE WITNESS: Right.

MR. CARTER: Before that, the channel was above them and they were mining under -- this is a large dish like this (Indicating). They were down here under the lip of the dish. There was water above them starting to drip, starting to drip. Then when they hit the bowl, the side of the bowl, they hit pay dirt. That's when it really started to flow.

THE WITNESS: That's correct.

MR. CARTER: Is that -- okay.

THE WITNESS: Absolutely correct.

MR. CARTER: That was my concept of what his testimony was. So all of this is channel water. None of this -- I won't say -- it's all part of this system.

THE WITNESS: I view this water that they first encountered that's on this hydrograph as being part of this sandstone channel.

Q (BY MR. APPEL) Is the sandstone that you believe is a channel fractured?

A I don't know.

Q Do the sandstones fracture in this area?

A We see -- when we find sandstones near the faces, they're really fractured. And when you find them at greater depth, you don't find that kind of fracture.

Q Isn't this area subject to regional fracture?

A There's some regional fracture.

Q Regional jointing?

A When I looked at the channel, I didn't see any fractures.

Q How many feet of the channel did you look at?

A Oh, a width of maybe total -- is a hundred feet -- is that a reasonable --

Q Answer from your memory.

A Well, okay. My memory would be 100 feet. We can have others testify.

Q In segments or continuous?

A In two segments.

Q How big were the segments, to the best of your approximation?

A One segment, maybe 25 feet; maybe one segment, 75 feet.

Q Will water in this particular vicinity move down vertically through these sandstones because of fractures?

A You mean the sandstone channel?

Q The sandstones in the area. We'll get to the channel.

A If you're near the surface, water will move really readily down through them. But you've got a series of intervening clays in the Blackhawk Formation. We're going to have clay layers in here, and those things make the groundwater flow in the Blackhawk discontinuous.

Q They slow it down?

A No, I mean discontinue it. They stop it.

Q The water piles up on top of them?

A What happens is, you can even run into sandstone channels are that completely dry. This is not uncommon.

Q Let's talk about the other feature you just discussed. You say the water would pile up on top of what?

A I didn't say the water would pile up. You're putting words in my mouth.

Q Well, you're saying you were encountering something other than sandstone?

A That's right, and we have a flux of water.

Q What is that?

A A flux? A flow.

Q No, no, no.

MR. CARTER: Let me see if I can short-circuit this, because I think there's a great deal of testimony that the horizontal permeability in this area generally is, in order of magnitude, higher than vertical. I think there's also agreement that there is some vertical permeability.

I mean, from my perspective, fracturing the sandstone is not the most important thing. The question is, Is there fracturing through the shales? I mean, the sandstones are vertical and -- vertically and horizontally permeable, presumably, and it's the shales that present the barriers to the vertical permeability.

MR. APPEL: Let me explain why I think this is important. If the sandstones are fractured, then it's less of a channel than he's telling us. The water is going to move from the top down through it as well as through the rock itself on a horizontal basis.

MR. CARTER: Let me ask you this geological question: You've got a channel and you have relatively permeable material underneath and we don't particularly care what's up above. Then it's not the fracturing in the channel that is of interest. It's whether the water passing through the channel vertically into the less -- into the coal, through the coal into the next sand, and through that sand into the next -- through the shale and -- I mean, it's vertical. Isn't that really the issue, what the degree of vertical permeability is? Well, don't let me tell you what your case is, but . . .

MR. APPEL: Okay. I understand what you're saying.

THE WITNESS: That's my understanding of it too. That's the way I view it.

MR. CARTER: Let me say this too, because at the end of this I'm going to ask for some briefing because I think this goes to a legal question, and that is, that everything on the planet is connected to everything else.

And the question is -- I mean, I think in one sense certainly this is a hydrologic system. It's the Wasatch Plateau. It's the drainage of this river. The question really is whether mining activity in this mine has -- I'll pull the terminology from our new water replacement law -- interrupted, diminished, or contaminated the water supply. That's kind of the crux of this investigation.

So there's going to be a question at some point, which I think is a legal question. Let's assume for a minute the rate of discharge of this system is a gallon a minute. Let's assume for a minute that gallon was making its way to Birch Creek or Bear Spring. I think that raises a legal question. I'm not saying that's the truth, but I'm saying that raises a legal question: Does the diminution of flow depriving Big Bear a gallon a minute constitute one of those three things we're trying to prevent?

You don't have to answer now, but I think I'm going to need the attorneys to tell me. Is there a de minimis rule here or is there any connection -- is there a factual determination or any connection? Must the Division take action? Must replacement take place?

And I think a related question is -- I made notes to myself and I threw them away and I shouldn't have done that -- must the water users quantify -- are the water users or water interest owners entitled to a de minimis exception? How accurately must they quantify the interruption?

Do you see where I'm headed? The bigger question here is how -- if one gallon a minute -- whether someone's liable to do something or has to do something based on one gallon a minute, does that also put a burden on the water users to demonstrate -- what's the order of magnitude water users would need to show? Would they need to show us one or five or in the neighborhood of a thousand? Would you have it make a showing of quantity?

The analogy here, I think, is damages. You know, you back into my car. The first question is, Are you responsible? Is there a causal connection? The second question is, How much? You know, what's the injury and what are you entitled to in terms of reparations?

So the caveat here is I'm not making -- I'm not saying I've decided anything about the science or the causal relationships or so forth, but I think whatever the evidence is, whatever the facts are, we're still going to have to have some briefing and argument on does 1 gallon a minute or 1.2 gallons a minute matter. So be thinking along those lines.

Go ahead.

MR. APPEL: But that doesn't take care of the issues concerning the adequacy of the PHC or --

MR. CARTER: Thank you.

MR. APPEL: You recognize that?

MR. CARTER: Thank you. That's another question, objection which has been raised: Did the Division, at the time it approved the PHC or purported to approve the renewal, have in its possession the sufficient information to make the conclusions it did? Are those conclusions adequate to support the issuance? You're right. Thanks.

Okay. So I think that's the context of what the Division has to wrestle with: the interference question and the "did-we-have-what-we-needed-when-we-did-what-we-did?" question.

MR. APPEL: Okay.

MR. CARTER: Did that derail a train of thought?

MR. APPEL: Several.

MR. HANSEN: You were talking about --

MR. APPEL: I know what I was talking about.

MR. HANSEN: -- sandstone fractures.

MR. APPEL: Maybe you could just take over.

MR. HANSEN: No further questions.

MR. CARTER: Dr. Mayo, I understand you need to leave at some point.

THE WITNESS: Yes, I need to leave as soon as possible. I need to catch a plane to --

MR. CARTER: I think in terms of this as well, I wanted to provide the opportunity for Co-Op to present additional verbal information and this sort of information as well. If there's a sense when we close that we need another affidavit or we need some other description, we can do that, but I think we probably ought to finish with Dr. Mayo as quickly as reasonably possible so we can let him go.

I'm sorry to use that precious time speechifying.

Q (BY MR. APPEL) You don't know what the source of water for the sandstone channel is other than surface recharge?

A That is correct. Let me clarify that. Well, that's -- yeah, that's correct. I don't know -- I -- I -- I don't understand the flow path from the surface to the channel.

Q Okay. But it could be roughly vertical from where the precipitation fell above?

A I have some trouble with that because of the nature of the Blackhawk Formation.

Q What trouble is that?

A The Blackhawk Formation, unless you're near cliff faces, does not transmit water very well.

MR. CARTER: Vertically?

THE WITNESS: Yeah, vertically or horizontally. It has real trouble. You get in a sandstone channel, you find some water, it has real trouble transmitting water because of the nature of the Blackhawk itself.

Q (BY MR. APPEL) And the Blackhawk, does that help create perched aquifers?

A Yes, whenever you get a sand that's in hydraulic connection somehow with some surface. And I think most of it's going on near cliff faces.

Q Now, you testified that you found water on the west side of the -- which fault is it?

A Big Bear.

Q Big Bear Fault. But --

A Oh, no. Blind Canyon Fault.

Q Blind Canyon Fault. That's right. But not on the east side. Isn't that a little odd to have one side of a fault that is as extensive as this carrying water and not the other side?

A I don't know if that's odd or not. I think that's kind of in keeping with how many faults will operate. You're offsetting stratigraphy. You're putting in fault gouge.

Q Answer the question. If you want to get out of here, you're going to have to confine your answers; otherwise, you'll be taking another plane.

A I'll try to curb myself.

Q I knew that would work.

Well, you've drawn on Exhibit 5 -- you have your sandstone channel, although we know it doesn't have to be that wide and we don't know how deep it is or thick, is bound by the faults. Is it possible that that sandstone channel is intercepting water that moved down the fault?

A It's a possibility, but I don't think so.

Q If there's water available that gets to the east side of that fault, it will move down the fault. Nothing especially odd about this fault, is there? --

A No, I would not say that it would move down the fault.

Q Parallel to?

A I feel more comfortable with "parallel to a fault" rather than "down a fault."

Q When I said "down," I meant downgrade in this instance. But it will move parallel to the lines of the fault on both sides of the fault?

A If both sides are saturated.

Q And I'm asking you to assume there's water on the east side of this fault. Do you believe there is water on the east side of that fault farther up into the mountain?

A At what stratigraphic horizon?

Q Any stratigraphic horizon.

A Well, because it's going to depend on which stratigraphic horizon you're in. Some of these will be dry; some will have water in them.

Q What is the throw on that fault?

A Is it 150 feet? Hundred to a hundred fifty feet.

Q And there is a superficial expression --

A Yes.

Q -- on the top of Gentry Mountain. So as it passes down through the various stratigraphic layers, if water's in that stratigraphic layer, will the fault intercept and move water?

A I'm not inclined to think of the fault as being this big conduit for water. The fault's full of gouge.

Q So this fault is not a conduit for water?

A Where I've visited this fault, it is not a conduit for water. Now, there could be some -- I need to elaborate a little bit -- there could be some sequence somewhere where you've got two good pieces of sand opposite each other and no gouge. Then the fault would be invisible to water or invisible to -- it would be an invisible barrier, be no barrier.

MR. HANSEN: Do we know that that ever occurs one way or the other?

THE WITNESS: It occurs some places.

Q (BY MR. APPEL) Based upon the information you have, has mining changed the historic underground flow of water?

A To the extent of 1.2 gallons a minute. I feel comfortable saying that.

Q And that's because of your sandstone channel?

A That's because of the sandstone channel.

Q And you're saying it's impossible for the mining efforts to have intercepted water that would historically recharge either Birch or Big Bear Spring?

A I feel really comfortable that it hasn't intercepted Big Bear Spring. And I don't see evidence, because of the fault and where the water is inside of the mine that they've encountered, that there is evidence to demonstrate that it has affected Birch Spring.

Q You, I think, testified that the creek is recharging Big Bear Spring?

A That's my opinion.

Q Tell me how that's going to work.

A Well, you've got a layer of rock that's really fractured because it's near the surface, and you follow the outcrop of the rock and it runs into the creek up gradient, and water flows down the creek and flows into the fractures and flows down and discharges out the face of the spring.

Q So you're saying that creek right there is a losing stream?

A I'm saying that it loses enough -- loses some water to get into -- to recharge the sandstone where the sandstone crosses it. It doesn't mean it's a losing creek at all times.

Q But there's no hydraulic head from that creek into that, is there?

A Well, the creek's higher.

Q Okay. But the creek is also flowing past that?

A Yes, uh-huh (Affirmative).

Q You're saying that the water that is coming down through the mountain from actual recharging in these fractures is going to be displaced by creek water?

A I think you're adding some things into my testimony that I didn't have in there.

Q Well, isn't water also moving down through these fractures --

A There will be some water --

Q -- naturally?

A -- naturally near the face of the cliff. It can move down. But if you look --

Q Stop right there. So isn't that water actually recharging the creek rather than vice versa? Isn't that some of the creek flow?

A It depends where you are. Some of it may be.

I'm not going to let you twist this too much before I tell the story here.

Q I'm not trying to twist it. I just find it interesting that you have a source of -- the source of water for the creek is the surrounding stratigraphy, correct?

A Yeah, snowmelt, upstream discharges. You know, you look at the hydrograph of the creek. It clearly mirrors what's going on with snowmelt and storm events and that sort of thing; so clearly it's what's going on in the near surface and the drainage area of the creek. That's where creeks get their water.

Q But that same snowmelt is moving down through the fractures in the rock as well, correct?

A When you're near the cliff faces, you're going to get some of that going in. But you've also got to look at what is your opportunity for snow to stick on a cliff face. It's not an easy task.

Q Let's get back to the point. There would have to be room in that fracture for the creek to enter, correct?

A Yes.

Q How far is the creek from the spring? Where do you think it enters?

A Oh, I don't know. Within a half mile. There will be some testimony more specifically about that.

MR. LEEMASTER: Mr. Carter, can I ask a question about that?

MR. CARTER: Sure. Oh, yeah.

MR. LEEMASTER: For the record, my name is Darrel Leemaster, Castle Valley Special Services.

So, Mr. Mayo, this point where you're saying the water would enter from the creek into the sandstone formation then move to our springs, is that below the discharge point for the Co-Op Mine?

THE WITNESS: I'm not sure.

MR. CARTER: We can piece that together.

THE WITNESS: That wouldn't be hard to figure out.

MR. LEEMASTER: What he's testifying here -- if this were true, this would be a terrible tragedy in that spring because the Division of Drinking Water would say that spring is surface-influenced, therefore you can't use it as a groundwater source; it has to be treated as a surface water source and I would have to treat that through a treatment plant.

MR. CARTER: What's the distance from recharge area to spring? I know there's a limitation because all springs are surface-influenced.

MR. LEEMASTER: And I don't know how they would define that. If it's as close as what we're talking from that creek source to my spring, I'm sure they would tell me that I can't use that as a groundwater source, it has to be surface-water treated and therefore would have to go through complete conventional treatment before I could use it. So this would be terrible for me.

UNIDENTIFIED SPEAKER: How could it get past Birch? It --

MR. HANSEN: This isn't the two springs; this is just Big Bear.

MR. LEEMASTER: Just Big Bear.

Q (BY MR. APPEL) Do you know whether or not the water encountered in the mine moves toward the east? It does generally, doesn't it?

A It's my impression that water in that channel -- the natural grading would be toward the east.

Q And water encountered in the mine because of the mine workings all goes to the east?

A I think generally.

Q You didn't really visit the eastern areas of this mine, did you?

A Not the closed areas.

Q Well, do you know from conversations if it's wetter over there because of water that's been encountered in the mine that's made its way there?

A I'm not sure.

Q Do you know whether the workings that have been closed have water in them, from your conversations?

A I'm not sure if they do or not.

MR. APPEL: Do you want to ask it?

MR. NIELSEN: Yeah. Been waiting for this.

MR. APPEL: This is it, Peter. Go for it.

MR. NIELSEN: Stewing for three months.

EXAMINATION

BY MR. NIELSEN:

Q Just a couple of questions on this hydrograph here. If I look at it after the intercept which was in the channel in '93, I see a steady decline in water which is, you know, transient state, dewatering the sandstone, but I also see peaks occurring roughly between May and June which corresponds to peaks in Bear Spring and every other spring in this area. Does this indicate a local recharge or is this a function of metering problems or what?

A I don't know. I don't think it represents local recharge. I think the age of the water is --

Q Well, that's true. I understand that. But you got a mixing phenomenon going on here. I also look at this and I say, well, I got peaks occurring quite often in June.

A I think we ought to ask Mr. Reynolds if he can help us.

Q So is it this or the fact that we have problems with metering?

A It could be a metering problem. It could be where they were actually going in and -- let's take some more --

Q The point I want to make is, we got to be careful with this graph because of the way the water was monitored.

A Yeah. I would not take any one of these points and say these are the absolute numbers.

Q That's the point I wanted to make. If you're hitting water at different sections, we've either got to say there are peaks on the decline which resembles all the springs in this area and Bear Creek or we got problems with metering. They may not be accurate.

MR. CARTER: I understood this to be offered to show -- and I'll be very general -- from the line to the last dot is a decline.

THE WITNESS: Is a decline, yes.

MR. NIELSEN: I agree it's a decline with peaks in it that occur in June. And then it declines.

MR. HANSEN: We're also talking about 1,500-year-old water.

MR. NIELSEN: Well, yeah. But that's what occurs in Bear Spring and all the other springs we looked at as well. It happens in Bear Canyon stream. It happens in Huntington Creek. I'm just pointing that out. We've got two things we're looking at here.

MR. SMITH: I've got one question on the chart, if I could interject.

MR. CARTER: Sure.

FURTHER EXAMINATION

BY MR. SMITH:

Q Dr. Mayo looking at your chart -- this is Exhibit 4 -- and then looking at the PHC and the CHIA, we have different numbers. Can you explain why the PHC and CHIA have different mine discharge numbers than your chart?

A No, I can't.

Q Where you did you take your numbers from?

A These numbers were provided by Mr. Reynolds.

Q And you have no testimony as to why they're at variance with the figures that are in the PHC?

A I have none.

MR. CARTER: Do you have questions, Mr. Hansen, or should we send Dr. Mayo away?

MR. HANSEN: No questions. I have a few questions, but I believe I can get them through my other witnesses. I don't want to hold Dr. Mayo up.

MR. CARTER: Dr. Mayo, thank you very much.

(Luncheon recess was taken.)

MR. HANSEN: One thing I forgot: We'd like to have this fault gouge from the Blind Canyon Seam designated as Exhibit C-6.

MR. CARTER: Okay. How we're going to put this in the file, I'm not sure.

MR. SMITH: Which map's that, Mark?

MR. HANSEN: It's the rocks.

MR. SMITH: Yeah. How are you going to . . .

MR. CARTER: Well, we may take photographs of it.

MR. APPEL: Could you provide us with copies? Yeah. I'd like to whack these rocks into four pieces.

MR. HANSEN: And put it through the replicator.

MR. CARTER: Okay. We'll figure out how we're going to go with that or how we'll work it.

Mr. Hansen?

MR. HANSEN: Co-Op Mine calls Chris Hansen -- I forgot. I'm sorry. Been a long day. Been a long week. Chris White -- Chris Hansen.

MR. APPEL: Are you two related?

MR. HANSEN: No. It has been a very long week for me. I offer my apologies.

MR. APPEL: I think we'll all just sort of disassemble at some point. Everyone's had a long week.

CHRIS D. HANSEN,

called as a witness for and on behalf of Co-Op Mining Company, was examined and testified as follows:

EXAMINATION

BY MR. HANSEN:

Q Could you spell your name, please?

A Sure, I think I can do that.

Q Would you give your full name for the record, please?

A It's Chris D. Hansen. C-h-r-i-s, H-a-n-s-e-n.

Q And where are you employed?

A EarthFax Engineering.

Q Can you give us your brief employment history?

A Okay. I can start with my educational background. I have a bachelor's and master's in geology from Brigham Young University. I received my bachelor's in '81 and my master's in '88. My master's work was the geology of the Jump Creek 7 1/2-minute quadrangle, which is located about 15 miles north of the Co-Op area. It included the structure and stratigraphic interpretation of the geology in that area.

As far as my professional background, I spent after school about eight years working in Nevada and Utah doing geologic studies not only in the coal industry but in the oil and gas business. I performed several stratigraphic and structural basinal studies. I've been at EarthFax since 1992. I've been working with several coal mines in the area. I participated in the preparation of PHCs for those mines -- for several mines, including the Co-Op Mine, Genwal, some of the Coastal mines.

Q What mines have you been in in the area?

A In this area, the active mines I've been in are the Genwal and the Co-Op Mine.

Q Have you been in other coal mines?

A Abandoned mines -- one in Nevada and Horse Canyon Mine.

Q Have you had an opportunity to examine the Co-Op Mine?

A Yes, I have.

Q Would you tell us what you did there.

A On the same day that Alan Mayo went in -- underground, I accompanied him -- he and Erik -- and essentially went to the same places he did.

Q And what did you observe?

A Well, I guess at this point it'd be easy to maybe start talking a little about the geology of the area, start with the stratigraphy and structure of the site.

Q Why don't we do that.

A Okay. Now, I don't want to spend a lot of time going over what Peter has already presented as far as stratigraphy, because it hasn't changed since he was out there. And --

MR. SMITH: I hope not.

THE WITNESS: -- and what I would like to do is put up a cross section. It's a general cross section that -- that we took from north to south through the permit area.

MR. HANSEN: Could we have this diagram marked as Exhibit C-7 for demonstrative purposes?

MR. CARTER: Certainly.

THE WITNESS: We took our cross section starting just north of the Co-Op drill hole SDH-2.

MR. SMITH: It's okay. My eyes aren't that good to be able to see your writing on this.

THE WITNESS: We purposely made it small.

MR. APPEL: Is it in Greek?

MR. SMITH: And I got my new glasses too.

THE WITNESS: Started up here by SDH-2 and essentially went down to Huntington Creek. The permit boundary -- the northern permit boundary is located here

(Indicating). The southern part of the boundary is approximately here (Indicating).

Q (BY MR. HANSEN) Now, this isn't completely to scale, is it?

A Not -- not totally, because we had to take a little bit of artistic license with the topography and the thicknesses of the formations because they have a tendency to change as you go.

Q And the vertical and horizontal scales are different?

A Yes. The horizontal scale is 1 inch equals 500 feet, and the vertical scale is 1 inch equals 200 feet.

Just briefly, the North Horn Formation -- in this area (Indicating) we encountered about 600 feet of North Horn where it consists of interbedded limestone, sandstone, shales, claystones, mudstones. Overlies approximately 230 to 260 feet of the Price River Formation, which consists of interbedded sandstones and shales.

Castlegate Sandstone, which is about 150 to 250 feet -- it's a conglomeratic sandstone and sandstone interbedded, a fluvial system.

The Blackhawk Formation, which is 600 to 800 feet thick, not necessarily on this cross section but in this area (Indicating). And it consists of interbedded fluvial sands, shales, mudstones, claystones, discontinuous sands, small -- relatively small channels. I don't want to put a size to them. The Blackhawk includes the major coal seams in the area.

Co-Op has mined in this area -- the Tank Seam, the Blind Canyon Seam, and then the Hiawatha Seam. The Hiawatha Seam and the base of the Blackhawk sit on top of the Spring Canyon member of the Star Point Formation.

And the Star Point Formation consists of essentially three tongues of sandstone interbedded or intertonguing -- intertongued by Mancos Shale. Thicknesses we used for these sandstone tongues come from the in-mine drill holes that Co-Op has put in and that EarthFax was involved in drilling.

And one thing I want to point out is, even though I've colored these yellow as sandstones, it's important to note that each one of these members is not just sandstone. It's a transitional sandstone that starts out at the base as a shale, siltstone, mudstone, and coarsens upward and becomes a fairly clean fine-to-course grain, well-washed sand. And then the cycle is repeated. You have shale that grades upward into more course material. It goes on up through the Spring Canyon.

On this cross section (Indicating), we've noted where the Birch and Big Bear Springs issue. And they're essentially coming from the base of the Panther Sandstone member and the Star Point.

And in fact, while I've got this up here, I'll just briefly touch on it: When these three holes were drilled in-mine, they were drilled through the three sandstone members of the Star Point Formation and into the Mancos Shale. And during the drilling of each one, the -- or of each well, each member of the Star Point was isolated while drilling, with packers set at the shale/sandstone contact. And the water level in the well was measured to determine what the potentiometric surface of the water within the sandstone was at that time. And I've depicted those measured potentiometric surfaces or that potentiometric point with this line (Indicating).

Q Now, Dr. Mayo testified that the potentiometric surface and the water table aren't exactly the same thing. Can you explain what he was talking about there?

A Well, as he said, the -- this point, for example (Indicating), is the potentiometric surface of the Panther Sandstone at this location (Indicating). That is not to say that the groundwater surface is the same thing. This point is a representation of the head of the water in the Panther Sandstone. The Mancos Shale in this area may or may not be saturated.

And what we're really seeing is that the Mancos Shale is acting as a confining unit and the water in the Panther Sandstone -- the water is in the Panther Sandstone. It rose up in the well to that elevation. It doesn't say that it's rising through the Mancos Shale to that point. It's just pressure of the water in the Panther Sandstone.

Does that explain what you were --

Q I believe so.

A We also put on here the potentiometric surface of the Spring Canyon sandstone member.

I think I'll just go on to the structure because I'm not sure that anything more can be said about the stratigraphy than what has already been talked about.

MR. CARTER: Let me ask you a question about potentiometric surfaces. I think I understand the concept, but with regard to that chart, the potentiometric surface that we have been talking about, the one I referred to that was first discussed several years ago as being the one we needed to be paying attention to, which was beneath the floor of the workings in the Blind Canyon Seam, is that depicted there.

THE WITNESS: It's this line that we've drawn

(Indicating).

MR. CARTER: Okay.

THE WITNESS: Right through here (Indicating), at this point and north, it's under confined conditions. From this point south (Indicating), it becomes unconfined. And again, this is not to say if I went to that point that there would be water in this formation. The water's in this member (Indicating), not up here (Indicating).

MR. CARTER: This is like being below the waterline in the hull of a ship?

THE WITNESS: Yep.

MR. CARTER: There's no water in there unless you poke a hole in the bottom?

THE WITNESS: Exactly.

Q (BY MR. HANSEN) Did you find more than one potentiometric surface?

A Well, we found -- in these drill holes we found a separate potentiometric surface for each of the members.

Q Now, this is just a general cross section diagram, correct?

A Yeah.

Q It doesn't purport to show everything you've encountered in the mountain if you cut the mountain in half?

A No, it -- no, it's not that detailed.

Q Do we see this sandstone channel that's been discussed on this diagram?

A At this scale, no, I do not depict it. And at this scale it might be fairly small. It might -- if -- something that Dr. Mayo did not mention is that we have some idea of the width of this channel just from drilling the -- Charles is aware of that -- they did at the face -- the mine face. And so if we were to show the location of that channel, it would be probably in this region right here (Indicating).

Q Would it be better for you or Charles to describe what we do know about that channel?

A I can -- the only thing I can tell you about it is I have seen it. It is definitely a fluvial channel. It is fairly -- at the part that I saw, the sandstone was fine-grained, well-sorted, clean, moderately well-cemented.

And then as Dr. Mayo pointed out on this exhibit, we saw it in two different faces, so we're assuming that it essentially cuts across east to west through this area (Indicating) with the flow -- the direction of the channel itself. I'm not saying the water in the channel. But when the channel was laid down, it was laid down probably in the east-west direction.

Q Do we know whether that channel dips below the bottom level of the Blind Canyon Seam?

A I have been told that the channel does not completely cut out the Blind Canyon Seam.

Q Could you go on, please?

A Sure.

MR. CARTER: Let me ask to clarify: I know the answer to this question, but I'm hoping to clarify for the group here, and maybe for the record as well, that my conception -- tell me if I'm right.

My conception of the creation of this channel we're talking about is that we have an environment in which coal is being deposited, organic material is being deposited, but it's in a transitional zone so that sometimes it's in a shallow embayment, where organic material is dying and falling into it, but it's also in an area where there are rivers basically meandering adjacent to a large body of water. And so at some point in this vicinity, a river meandered its way over to where the channel is now, scoured out some of the coal, filled it with sand, and then moved on. So that's basically the depositional environment for which the channel occurred.

THE WITNESS: Yeah. You could liken it to the

Mississippi River delta, where you have cut off which once was the main channel and now has been abandoned and eventually, if the Corps of Engineers has their way, fill back in.

MR. LEEMASTER: Mr. Carter, I'm a little bit fuzzy about that too. Would it be possible for him to sketch in where that layer is where so we can tell where the coal layers is you're drawing?

MR. CARTER: Everything below that line is coal, right? Draw in the floor would be the thing to do.

THE WITNESS: If we were going to -- it's -- that would be the floor of the coal (Indicating), and from what I've been told -- let me draw it down here a little better.

If this is the channel geometry (Indicating) -- and I don't know what this distance is here (Indicating). And if this -- we'll call this the coal seam (Indicating). It's essentially that geometry (Indicating).

MR. LEEMASTER: So your understanding is, that channel doesn't go quite to the bottom of the coal area but that it does spill out over the top --

THE WITNESS: Yeah. We were able to, in the mines, see distance back from this face (Indicating) sandstones that were related to this channel that would be part of the channel sandstone.

MR. CARTER: That's a good picture to illustrate. This was a revelation to me as well, that the water that's occurring in the north end of the mine is coming, again, from above, it's thought, out of the -- of a channel rather than welling up from the floor.

THE WITNESS: Yeah. To maybe help -- and I don't know. I'm not going to draw this to scale, but somewhere down here (Indicating) is the Spring Canyon that has water under pressure --

MR. CARTER: Yeah.

THE WITNESS: -- in it.

Q (BY MR. HANSEN) That line you've marked as and labeled "SC," that is the water table that feeds the spring?

A No, not necessarily.

Q What is that?

A That's this member (Indicating) of the Star Point Formation.

Q Is there water between that line that you've labeled "SC" to the bottom of the Blind Canyon Seam?

A Is there water in here (Indicating)?

Q In that space, yes.

A In the shale? Well, I'm sure that there's water in the porous bases of the shale. But if you ask me whether it's moving through there --

Q Do we have any evidence that there's water in that area that is coming up through the floor into the Blind Canyon Seam?

A I did not see any water coming up through the floor. All the water I saw coming into the mine through this area was coming through here (Indicating) or coming (Indicating) . . .

MR. CARTER: Okay. Thank you.

THE WITNESS: Briefly, I'll move on to the structure. As Peter talked about in his presentation, this area of the Wasatch Plateau has several in-echelon normal faults that are trending north and offsetting to the east. What I mean "offset in echelon pattern": they tend to start stacking to the east.

The permit area is bounded on the west by the Blind Canyon Fault and on the east by the Bear Canyon Fault. And we've made an attempt at a three-dimensional diagram here that --

MR. HANSEN: Can we mark this Exhibit C-8 for demonstrative purposes?

I assume you're going to want copies of all these, correct?

MR. APPEL: Yes.

THE WITNESS: Blind Canyon Fault is located here on this diagram (Indicating). If this is -- if this is north (Indicating), the Blind Canyon Fault trends to the north. This is just the fault trace on the surface. There's another fault located parallel to it. Birch Springs is on the west side of both of these faults. Bear Canyon Fault -- the fault trace is located parallel to a portion of Bear Canyon, cuts across the canyon floor, and then comes up the other side of the mountain, but, of course, we couldn't quite illustrate that. The green area is very roughly where they've mined.

Q By that, do you mean in the Blind Canyon Seam?

A Yes, I'm sorry, the Blind Canyon Seam. This does not illustrate the Hiawatha or the Tank Seam.

In this area I'm going to have to mark on this map or on this diagram. As Peter stated, there's a system of joints and fractures that are not necessarily parallel to the faulting but are at an oblique angle to the faulting. And if I were to draw it on here, they run about 15 to 17 degrees east of north. So they're -- they'd be something like -- if I can do this -- in that angle (Indicating).

Now, there's a second set, a minor set of joints that run at about 60 degrees east of north. So if I were to try and draw that, they would be something in that orientation (Indicating), maybe a little less. I'll mess it up if I do any more. But that pattern seems to be common throughout this area.

Now, the structure at the springs themselves -- Big Bear Spring is issuing from a joint within the Panther Sandstone. The joint trends basically 15 degrees east of north, so it's within this system of joints. There are joints all along this face of the Panther Sandstone that -- broad or wide intervals of the secondary joints that cut through the whole mountain.

Birch Springs is similar in that it's associated with a fracture and there's a minor amount of offset; it appears to be less than 10 feet. And it's -- there are also the secondary set of joints in that spring location.

Dr. Mayo has already discussed this fault where -- they encountered in the Blind Canyon Seam. I visited the same location. I can confirm that it was dry. I don't know that I can really say anything more about that.

I have observed fractures -- observed fractures within the mine -- actually, in both the Tank and the Blind Canyon Seam -- and there was no water coming through these fractures. And, in fact, the fractures had no evidence of water having moved through them except in the Blind Canyon Seam in that wet area.

Q Could you point out where that area would be on this Exhibit C-8?

A Sure. That would be up -- up in this area right here (Indicating), up on the north end of the mine workings.

Q Is that the same area where the channel would be?

A Yes. But not knowing the exact geometry of that channel, I didn't feel comfortable putting that in.

Q But the channel would cut approximately in an east-west direction?

A Across here (Indicating).

Q Towards the top of where the green area is shown on that exhibit?

A Yes.

And one thing I would like to say about both the stratigraphy and the structure in this area is, it's important to realize that when this area has undergone tectonic stresses -- folding and faulting, compressional, tensional forces -- the sandstones have reacted brittle; they'll break. The shales, the mudstones, the claystones act more plastically and they'll flex. They will fracture but not at the same rate that the sandstones will. Plus, when the shales and the claystones are exposed to water, they have a tendency to swell and reheal themselves.

Q Is that just theory or has that been observation?

A That's been my observation, my observation at the outcrop, my observation from drill hole data that -- and drilling logs from the wells that Co-Op drilled on top of the mountain up here, plus my own experience in drilling in these same formations.

Other than that, I don't have much more to say about the geology.

MR. HANSEN: Gentlemen, do you have any questions? I'm sure you do.

MR. APPEL: Is this the end of his testimony?

THE WITNESS: Oh, well, let me back up for one minute. I did create a geologic map of the area following Doelling's presentation. This is the Bear Canyon Fault (Indicating), Blind Canyon (Indicating). And then the Pleasant Valley Fault is over here (Indicating), which is probably the major bounding fault for this area. The Bear -- Big Bear Springs is located in this area (Indicating), about a quarter of a mile from where Bear Canyon Creek crosses over the Panther Sandstone.

And Birch Springs would be -- this is easy; it's already marked -- would be in this area

(Indicating). Woops. No, it's not. Over here (Indicating). It wasn't so easy after that.

Can I have your eraser?

MR. HANSEN: May we mark that diagram, Exhibit C-9?

MR. APPEL: For demonstrative purposes?

MR. HANSEN: Certainly.

MR. CARTER: You are doing too many trials, Jeff.

MR. APPEL: If you think that, imagine how I feel.

MR. SMITH: Is that it?

THE WITNESS: I think that's it.

MR. APPEL: Do you have any other purposes this witness can serve?

MR. HANSEN: He's all yours, gentlemen.

EXAMINATION

BY MR. APPEL:

Q I don't want you to think I'm Dr. Mayo because I'm standing up on you.

(A discussion was held off the record.)

Q (BY MR. APPEL) You mentioned -- just trying to become more conversant with this cross section -- I appreciate your willingness to give us a copy of all these exhibits. You testified you only know the thicknesses of these various sequences at the site of the drill hole?

A Uh-huh (Affirmative).

Q And you have a total of, I guess, four drill holes?

A Three which penetrated the full thickness of the Star Point Formation.

Q Okay. And the width between the two faults is how far?

A The width between the Blind Canyon and the Bear Canyon fault?

Q Yes.

A I can measure that.

Q You can tell me -- well, why don't you measure it; then we can have that.

A 3,250 feet, according to Dr. Mayo's work.

Q And how wide are each of these drill holes?

A How wide? What diameter of the drill holes?

Q The diameter of the drill holes.

A I would assume they're 4 inches in diameter.

Q Is there a map that shows where the drill holes are?

There we go.

A Yeah.

Q So referring to what is Exhibit 1 --

MR. CARTER: I think that's on the water users' Exhibit 5.

Q (BY MR. APPEL) It doesn't show four.

Let's put this one up, then (Indicating). This is referring to Exhibit 1. Where would 3 be, the abandoned drill hole?

Did you find that the precise thickness of each of these sequences -- does this reflect that you found a precise thickness of each sequence in each of these drill holes?

A With -- probably within a foot or two.

Q Okay. So you believe on that basis that it's continuous throughout this section moving through the mountain?

A Yes, based on the drill hole data and the outcrop that I observed in the area.

Q Okay. Now, don't the shale layers tend to vary in thickness within these --

A Yes, they will vary between zero and several hundred feet. But the dramatic change occurs in the east -- or west-to-east direction, not the north-to-south. The depositional strike of the Star Point Sandstone is from west to east. As you go to the west toward Joe's Valley, the sandstone members begin to intertongue more closely, the Mancos Shale begins to pinch out. As you go east from that area, the Mancos Shale tongues tend to thicken. So if you're on a north-to-south trend, the thickness of the tongues does not vary dramatically. Does that make sense?

Q It does.

Is there a place where sandstone could rest on sandstone with no Mancos Shale?

A It's always possible, but it's unlikely, given the depositional environment for those sandstones.

Q But if it did, the Mancos Shale would not bear and provide a confinement layer the way you've interpreted it here?

A If there is no Mancos Shale tongue --

Q Uh-huh (Affirmative).

A -- there would be no confining layer?

Q Uh-huh (Affirmative).

A That would be true.

Q And this is all based upon a depositional sequence, so if there was a material providing a basis for the Mancos Shale to be deposited and it's deposited in thicker layers someplace and thinner layers in other places, it's because of nature?

A Yes.

Q Same with the sandstone?

A True.

MR. CARTER: I got a question. For instance, if this is an area characterized by channels -- or we found a channel?

THE WITNESS: Yes, but that's in the Blackhawk Formation, not -- the difference between the Blackhawk and the Spring Canyon is, the Blackhawk Formation is a littoral, brackish water --

MR. CARTER: -- back bay lagoon.

THE WITNESS: The Star Point Formation is a strandline beach, prodeltaic system, which tend to be more uniform because you're looking at transgressive/regressive sequences.

MR. CARTER: So it's unlikely that the channel formation we find in the Blind Canyon Seam would be present in the lower sand units?

THE WITNESS: In this area, yes.

MR. CARTER: Which could conceivably create a hydraulic connection through more -- I mean, in this area if that channel were deeper -- let's say if the scouring had gone all the way through the coal into sand below, it would be limited in aerial extent but there could be a connection?

THE WITNESS: It's possible, but I think that is yet to be seen on the Wasatch Plateau. There are no deep channels like that that we've observed.

MR. CARTER: Thank you.

Q (BY MR. APPEL) Do you believe the water moves between the various members of the Star Point Formation?

A Given enough time and -- that could occur, but you're talking permeabilities that are exceedingly low.

Q What if they are bound together by common joints and fractures?

A It's unlikely because of -- the common joints and fractures would seal themselves in the shale.

Q What if it's a very thin layer of shale between the two of --

A How thin is thin?

Q What if it's one inch thick?

A Then it's probably likely to go through. But in my opinion, there's no shale here that's only one inch thick.

Q So water entering the Star Point (Indicating) -- I'm sorry -- the Spring Canyon member -- will never converse with the Storrs member or the Panther Sandstone member. Is that what you're saying?

A Not never. That's pretty absolute.

Q Would it have someplace else it would rather go, "it" being the water?

A Yes.

Q Where would it rather go?

A The conductivity in these members is -- well, let me back up. It would go laterally, or horizontally, instead of vertically.
Q So it would move down this way (Indicating) in each of these sandstones and find the air here?
A Yes.
Q Have you seen any springs here?
A Uh-huh (Affirmative).
Q How large are they?
A They're not significant. I wouldn't -- I wouldn't guess a flow, but you're not talking 40 or 50 gallons a minute.
Q Have you seen them in the permit area?
A No. What I'm saying is, in the permit area there are springs, but these are insignificant flows.
Q Okay. More like seeps?
A Uh-huh (Affirmative).
Q Okay. Same situation --
A Uh-huh (Affirmative).
Q -- with the Storrs member?
A Uh-huh (Affirmative).
Q The same situation from the Panther Sandstone member?
A With the exception of Birch and Big Bear.
Q Are there any other springs of the size of

Birch and Big Bear in this area above them?

A In that formation?

Q Uh-huh (Affirmative).

A Not that I'm aware of.

Q Any other formation?

A There are significant springs in the North Horn Formation.

Q Up here (Indicating)?

A Uh-huh (Affirmative).

Q Okay. And is it the Price River Formation that drives those?

A No, it would be the shale members within the North Horn Formation that drive them up.

Q And water, recharged water is going to land on the North Horn Formation here, and is it going to run off as surface water or is some of it going to move down?

A A small percentage of it may move down.

Q Okay. And that would cause some of the springs you mentioned here?

A Uh-huh (Affirmative). Yes.

Q Stand up, if you would, and pretend to be Dr. Mayo again. I'm sorry. I just can't resist.

A I wouldn't even pretend to do that.

Q Your hair's too short.

A It's almost gray enough.

Q Water falls here (Indicating). Show me where, based upon your geologic inquiry of this area, you think the water's going to be.

A Ninety percent of it's going to run off at the surface. Ten percent or less may come in here (Indicating), hit an impermeable unit, come out here (Indicating). It may never daylight to the surface. It may fall through the soils down to some point in here (Indicating). Say that happens to another 80 percent of the 10 percent. Now we're down to 2 percent of the water. And it may travel a little bit farther and come out here (Indicating). Then we got another smaller percent that eventually, over -- in geologic time we're talking, perhaps, not a significant amount of time, but in your time -- in our understanding of time, it would take thousands of years to get down to here (Indicating).

Q Okay. So what water is forming this potentiometric surface you've drawn here? Is that the groundwater table, in your estimation?

A No, it's not the groundwater table. It's the potentiometric surface.

Q Where would the groundwater table be? Higher?

A No. It depends on each location. You could have these perch zones where you would have a separate and distinct groundwater surface, but as far as the groundwater table goes, it's -- you really cannot say the potentiometric surface is the groundwater table.

Q Okay. What do you mean by "potentiometric surface" when you draw it here?

A If I were to drill a hole -- well, such as this one -- into the Spring Canyon, this water will rise within that well to this point (Indicating).

Q So is there water moving through the Blackhawk Formation at all down?

A At an incredibly slow rate.

Q Where does the water come from that provides the source for Birch and Big Bear Spring?

A The only answer I can give to that is that it comes somewhere north of the permit area.

Q And here's your permit boundary here (Indicating)?

A Uh-huh (Affirmative).

Q Do you believe some of this water's moving down?

A No.

Q No?

A Not -- okay. Yes and no. A very small percentage, incredibly small percentage of it is moving down.

MR. CARTER: Let me ask a question because we're only looking at one dimension here. That is, if you look at the geologic map -- and anyone correct me if I'm wrong here -- it is a general proposition rock units that are aquifers get most of their recharge -- or the best opportunity to recharge is where those units are exposed at the surface.

The classic would be the Navajo Sandstone, which is recharging way out to the east of us here but then plunges beneath the Wasatch Plateau. The surface out there is 7,000 feet, where Texaco has its injection well. And the -- that is not being recharged because it's overlain where Texaco has its well by Mancos Shale and a whole bunch of other stuff.

Most of the water, if not all of the water that's getting into that, just in terms of large percentages, is coming from where it's cropping out, where the snow lands there, melts, and gets into it.

So isn't it likely, or possible at least, that if it's having difficulty coming straight down through a bunch of very low permeability layers, that if you look at the geologic map, you can see that it crops out up the canyons, where the canyons are incised. And where it's -- and the best way that I've got: impermeable layer, permeable layer, impermeable layer.

Just relatively speaking, the best place to get water into it is from the sides rather than from the top or the bottom, so the most effective source would be -- I mean, I don't -- this is not testimony, but I'm just remembering my geology. You got to put the water into the container where there's an opening.

MR. APPEL: Maybe I can ask a question and we'll follow up on that.

Q (BY MR. APPEL) You see an outcrop of any of these formations up-canyon?

A Yes.

Q Where?

A Tie Fork, which is -- it would be on this map (Indicating). This area up here (Indicating).

Q Which formations do you see?

A Well, it's -- see the Mancos Shale, Star Point, Blackhawk, Castleview, Price River. The whole sequence is essentially exposed in this area.

Q How far above stream level are they?

A Depends on where you are, because the canyon is not level. As you go up-canyon, you're crossing each one of these outcrops. For example, the Star Point is an outcropping up into this area (Indicating). The Blackhawk is exposed in the bottom of the canyon here (Indicating).

Q And that's outside of our graben area, isn't it?

A No, it's actually within the graben, this being the boundary of fault (Indicating).

Q So you're saying in here (Indicating)?

A Uh-huh (Affirmative), though it isn't drawn on there.

Q And you think that's the recharge area for the Birch and Big Bear springs?

A No. I'm saying a potential recharge area, not necessarily for these springs but for this formation. It could recharge that formation.

Q Have you done a water budget?

A No, I have not.

Q Has anyone?

A Not that I'm aware of.

Q Okay. Is there a water budget in the PHC?

A Not that I'm aware.

Q Okay. Did you do any work on the existing PHC?

A No. I have only reviewed it.

Q Who did that work?

A John Garr and some other employees at EarthFax.

Q Who were the other employees?

A Rich White and --

Anybody else?

MR. WHITE: It was predominantly who it was.

Q (BY MR. APPEL) Do you know who did the field work?

A Field work as far as the in-mine drilling?

Q Well, and additionally, to determine whether or not there were the fractures and jointings occurred on the surface.

A For the PHC, John Garr would have done that work.

Q Does the PHC reference regional faulting and jointing?

A Yes.

Q Throughout the stratigraphic sequence?

A In the general sense, yeah.

Q Do you believe that's a correct conclusion?

A That --

Q -- there is regional faulting and jointing throughout this entire sequence.

A Oh, yeah.

Q You mentioned that you saw water coming from fractures in the north end of the mine, which was here (Indicating)?

A Uh-huh (Affirmative).

Q Where is that on this map, on Exhibit C-7?

A That would be approximately up in here (Indicating). Water is -- or the -- yeah, the water was coming out of the roof.

Q Okay. And that's from the sandstone channel, as you've referred to it?

A Yes.

Q How does the water get to the sandstone channel?

A I'm not sure that I know where it comes from.

Q Do you agree with Dr. Mayo's conclusion it is coming from the surface?

A Only in the fact that all water in the groundwater surface -- or groundwater system comes from the surface.

Q Do you think it could have come from the surface directly above?

A No.

Q So it is coming from unknown destinations or sources to the north too?

A It's -- in my opinion, it is coming from sources that would be north of the permit area.

Q What do you base that opinion on?

A As we discussed earlier, the extremely low permeability of the overlaying units.

Q Okay. Do you know if that sandstone channel is continuous with other sandstone channels?

A No.

Q Okay. What's it connected to that would put so much water in it?

A A gallon and a half a minute? It could be exposed to the surface where a stream is currently running over it. It could be coming from another discontinuous sand. There's a potential circuitous route. I'm not sure what it would be.

Q So is it your testimony that the Blackhawk Formation is -- what's a good word to use? -- there's an impermeable barrier between the Blackhawk and the Star Point Formation?

A It is an impermeable barrier.

Q Is there any communication between those two that would allow water to move down?

A At a very incredibly slow rate.

Q What about if there were fractures?

A The fractures would have a tendency to heal themselves.

Q But what if you have a whole series of sandstone channels? Could those rest on the Star Point Formation?

A Yes, but you would -- it would be highly unlikely to have a series of sandstone channels that would stack themselves the length of the Blackhawk Formation or the width -- the thickness, rather, of the Blackhawk Formation.

Q Doesn't Dr. Mayo's drawing of the sandstone channel show that it's discontinuous within two fault boundaries?

A He's only shown those as boundaries, not that the channel is only here at this location. He's saying that this is the location of the channel between these two faults.

Q Do you think it's on the other side of the faults?

A It's reasonable to assume that.

Q Okay. The same stratigraphic level?

A Same stratigraphic level but not the same structural level.

Q In any event, the mine is very wet up in here (Indicating)?

A There is water that is coming out of a channel and near the face, roof dripping.

MR. APPEL: That's all I have.

MR. SMITH: I just got a few questions.

EXAMINATION

BY MR. SMITH:

Q This is Exhibit C-7. Before I ask you about

this, let me ask you, What were you asked to do by Co-Op in connection with why you're here today?
A To review the geology and structure of the area, to determine what effect faulting would have on this area, do a little surface mapping, and generally present any information that I observed in the mine.
Q Did you gather new data or just reevaluate existing data?
A I did some surface work, reviewed existing data.
Q When you say "surface work" --
A Surface mapping.
Q Any other data gathering besides that?
A Other than adding in, helping collect in the isotopic samples, I wouldn't say -- yes, I would say "No" to that.
Q Okay. Now, Birch and Big Bear Spring, they both issue from the Panther Sandstone; is that correct?
A The base or near the base of the Panther.
Q Then I take it they both issue out of faults or fractures?
A Yes, on top of the Mancos Shale.
Q So that's a fracture in the Panther Sandstone; is that correct?
A Right. It's sealed -- if it actually

continued into the Mancos Shale, it's apparently sealed itself, so it kicks out at the contact of the two formations.

Q That's at the bottom, right? You're saying that the Mancos Shale is kind of a floor and that's where it comes out there; is that --

A Right.

Q Do I understand that?

Did you make any effort to try to follow the fractures from -- let's take Birch Spring, for example. Did you follow the fracture from Birch Spring?

A On the ground I was not able to, but with aerial photographs I tried to trace it.

Q Does it continue into the next layer, the shale layer above the Panther Sandstone?

A There are fractures within the overlying sandstone units that appear to be in the same vertical location, though between the sandstone members, the shale is not exposed -- not well exposed, so I couldn't say for certain that those were the same joints or fractures.

Q So you couldn't tell but thought there were joints that extended through the shale into the next sandstone layer?

A I guess what I'm saying is, there were joints in the sandstone that appear to be vertically in line with the joints -- joints in the Storrs that are vertically in line with those joints that are in the Panther.

Q I see. So there were joints in the Storrs that are in line with the Panther Sandstone?

A Uh-huh (Affirmative), but I cannot say they were exactly the same joint.

Q Is the Mancos Shale -- is that exposed? Did you see that?

A In certain areas, yes. Not all at the springs.

Q Okay.

A I mean, there is Mancos Shale exposed at Birch Springs. There is some Mancos Shale and shale tongues exposed in the area of Big Bear.

Q Now, there aren't any major springs that issue out of the Storrs Sandstone?

A Not that are flowing 30, 40 gallons a minute.

Q And I take it the same's true out of the Spring Canyon Sandstone?

A In this area, no.

Q Any reason why the two major springs in this area both come out of the Panther Sandstone?

A It could be several areas: One, the Spring Canyon and the Storrs are less permeable than the Panther Sandstone. And that's from information that we got --

that EarthFax generated when they did their slug tests within these drill holes. They found the Panther is more permeable than the Storrs and Spring Canyon.

Q Okay. Any other thinking on that?

A Well, I think, going back to what Dr. Mayo said, at least for Big Bear Spring, we appear to have a direct communication between the creek and the spring itself through a system of fractures and joints.

Q But that's obviously not true of Birch Spring?

A Right. There is no communication from Big -- or Bear Canyon Creek and Birch.

Q And Birch is above Huntington Creek?

A (Witness moves head up and down.)

Q Where do you believe that the recharge is for Birch Spring?

A I can tell you that I do not know where it is, other than I do not believe that it's in the permit area.

Q Okay. And why don't you believe that?

A Because the vertical permeability is so much less than the lateral, horizontal, permeability of the formations.

Q So you think it's somewhere farther north, or whatever direction this is?

A Uh-huh (Affirmative).

Q That doesn't mean the water can't be

intercepted in the permit area that would eventually end up at Birch Spring?

A It would have to be coming vertically through the mine area to reach that point.

Q Well, doesn't your map show that the water -- let's take the potentiometric surface -- moves, you know, vertically, there's a vertical aspect of the potentiometric surface as well as horizontal aspect?

A That's only a pressure head, a pressure representation. That's not a representation of the actual water surface.

Q Why don't you show me on this map where the mine's encountering water, because it is encountering water, correct?

A On the north end near the sandstone channel, which would be in this area right here (Indicating) -- well, let me back up, maybe make it a little bit --

Q That's very near where you show the potentiometric surface. Is that just by coincidence they happen to be together?

A I think unfortunately, yes, because that water comes out of the roof, not out of the floor.

Q Which way is the water moving? Dr. Mayo said the water was moving. Which direction is that water moving?

A It's a good question. It's moving out of the channel somewhere. And at this point it's moving into the mine. Prior to mining up against it, it was moving through there at a gallon and a half or less -- assumed gallon and a half or less to some location. And it may not have been daylighting. It may have been going into another formation.

Q Well, you just don't know. Is that your answer?

A I just don't know what?

Q You just don't know where the water was moving prior to the mining?

A That's probably -- I couldn't put my finger on where -- on a direction where it was moving. But I believe what he has calculated to be accurate: in the realm of a gallon and a half a minute, more or less.

Q And explain that so I understand what "gallon and a half" means.

MR. HANSEN: For clarification, the actual number was 1.2.

THE WITNESS: Okay. I'm sorry. That's just the throughput.

Q (BY MR. SMITH) Throughput. Gallon and a half moving through what?

MR. CARTER: From one end of this channel segment to the other. Based upon the approximate amount that had been discharged out of the channel and the age of the water in the channel and the curve, I think he was saying we have a vessel that holds about a billion gallons of water and it's moving through the vessel -- it's not static but it's moving at the rate of about 1.2 gallons a minute.

I mean, he was trying to match age, residence time, velocity, and volume to come up with a -- you know, when it comes in, how long does it take to move through and how fast is it going?

THE WITNESS: Right.

Q (BY MR. SMITH) Now, Dr. Mayo's figures were based on flow, groundwater discharge figures that are shown on Exhibit 4; is that correct?

MR. CARTER: Well, my understanding was, he was utilizing this exhibit as the basis for determining -- basically -- it's like a decline curve sort of analysis, trying to determine what the volume of the vessel was.

Q (BY MR. SMITH) So that's what he based his calculation on was those discharge figures; isn't that correct?

A Well, I'm not sure -- I don't feel comfortable answering that question because I -- it's not my testimony.

Q Let's go on to the next question. Can you explain to me why the numbers are different on this exhibit than they are on the PHC and the CHIA as far as the discharge?

A Well, the CHIA is a state document. The CHIA is supposed to be prepared by DOGM.

Q How about the PHC?

A I have no -- I have no opinion on that. That is something you could ask Charles.

Q I guess we'll have to ask him that question why we have different numbers.

A Are you sure that we do?

Q I'm happy to point them out. I've got the documents here.

MR. CARTER: What are they?

MR. SMITH: Well, they're as high as 300 --

MS. MATTSO: Can I ask a point of -- Liane Mattso, Forest Service. Is what you're thinking of is that discharge water what they're actually pumping out of the mine and what they're talking about is the water that's flowing in from the channel? Is that where we're getting caught up in semantics?

MR. SMITH: No, it really isn't. The difference is, we have two sets of numbers that, for whatever reason, Dr. Mayo relied on and what's been reported in the PHC to the CHIA, and also in the CHIA, as to what the flows are encountered in the mine.

MR. CARTER: What flows do they report? As high as --

MR. SMITH: As high as 300 and nothing anywhere near 300. And that's a total. We're talking about total both used in the mine and discharged out of the mine.

MS. MATTSO: Well, my question -- what I'm trying to -- because I get confused listening to you guys. What -- I'm wondering if these guys are talking about discharge from this channel that's coming into the mine and what you're referring to is what is being discharged from the mine and being measured outside.

MR. SMITH: What I believe I'm referring to is just the total water that's measured -- used in the mine or discharged out of the mine. I thought, you know, Dr. Mayo's numbers were the same, but they seem to be different than what's in those documents. That's why I'm trying to --

MR. REYNOLDS: Maybe I can clarify this right now. These numbers are the numbers that have flowed from --

MR. HANSEN: "These numbers," meaning numbers in Exhibit C-4?

MR. REYNOLDS: Yes.

-- from the channel. The maximum number of 300 gallon a minute you're referring to -- in my testimony I did mention another point, SPC-10, that we mined into for a short period. We encountered about 250 gallon a minute, which immediately dried up.

MR. CARTER: Oh, that was the fault-related water?

MR. REYNOLDS: It was not -- it was over near a fault on the east side. It was also near this channel, but we did not encounter either -- we just ran into basically what appeared to be a perched aquifer that drained.

And the figures you're looking at are just -- in other words, the figures in the PHC represent average numbers. This 300 gallon a minute you're talking about represents at one point in time the maximum that has ever flowed from the whole mine together from all points in the mine.

MR. CARTER: So I understand, Exhibit C-4 is intended to show the water coming from the channel --

MR. REYNOLDS: That's correct.

MR. CARTER: -- and not supposed to show all the water coming out of the mine, just the channel?

MR. REYNOLDS: It is -- in fact, at this point in time, it is -- 95 percent of what's coming into the mine is coming out of the channel right now, but --

MR. APPEL: And the rest comes from where? Roof drips?

MR. REYNOLDS: I mentioned we do have a small bit of water that has just started flowing out of the gob that we've begun monitoring.

MR. CARTER: That's on the east side of the mine?

MR. REYNOLDS: Yes. It's --

MR. HANSEN: Do you have any problem with this, just to clear things up?

MR. SMITH: No, I'm happy to let Charles clear things up.

MR. CARTER: While we're on it, I said two or three times the last few times that this was informal. It's gotten quite formal. And as long as the parties are comfortable with that, you can do that. But I think it's helpful to clarify the record as we get to these issues.

MR. HANSEN: I would certainly prefer clarity over formality.

MR. CARTER: Okay. Let's have both.

Go ahead. Sorry.

MR. REYNOLDS: Just within the last five, six months we've encountered some water. I think our last measurement was around 18 gallon a minute, what we estimated that, flowing out of this gob.

MR. APPEL: Going back into the area you're mining now?

MR. REYNOLDS: Back in the mine.

MR. APPEL: Which indicates there's quite a bit of water in your gob?

MR. REYNOLDS: Which would indicate it's probably flowing through the entries. In other words, we did have about 20 gallon a minute that was flowing here at the time that we pulled pillars. And we suspect that water has just flowed through the workings and is now coming back into the mine.

MR. CARTER: It's made its way back to the mine.

THE WITNESS: So it's not crossing the faults.

MR. REYNOLDS: No, it doesn't appear to be crossing the faults.

MR. APPEL: Isn't the slope of the floor in those workings toward the east?

MR. REYNOLDS: It is.

MR. APPEL: So in order for that to be coming down and filling up here (Indicating), you have to fill up the levels down to the east, right?

MR. REYNOLDS: No, not necessarily. When we mined this, we did have floor coal. And in pulling these pillars, the way we'd pull it is, after we'd make a -- we've got a pillar here. Mine the pillar. First thing you do is you split it in half; then you turn and make cuts into that pillar about like that (Indicating). And what happens is, they'd mine that; then they'd come back and mine out the floor.

THE WITNESS: Now, is this looking down or cross section?

MR. REYNOLDS: This is looking -- a plan view of the pillar.

And so what you do is, you create basically some bowls in the floor, small sumps that may fill up as the water moves. Depending on how much coal or where you filled up would determine the direction it's going.

And then also where we were mining against this in-mine fault and we did not penetrate that fault, that would also be a barrier for any water from moving to the east. It would hold it this way. We do also in-mine.

Although the general trend's that way, this map shows it a little better (Indicating). The actual contours of the floor are actually shown right here, and we do have quite a bit of variance right here. We have a low point; then we had a high point, which came through here (Indicating). And it was actually downhill, then back uphill, then downhill right in the mine. So you have all kinds of variations like that that are going to influence the direction the water's going to flow.

This is the only place we've had water flowing out of the gob. We do have a --

MR. APPEL: Is it flowing through a pipe or is it just seeping?

MR. REYNOLDS: It's seeping --

MR. APPEL: So there's a head behind it?

MR. REYNOLDS: -- onto the floor of the mine.

MR. APPEL: Is there a head behind it?

MR. REYNOLDS: I would say no. As this area's kind of filled up, the water -- it's just an open flow along the floor.

UNIDENTIFIED SPEAKER: You have not sealed that section, then?

MR. REYNOLDS: We've built -- sealed, but we have not finished sealing this off yet. We have been in the process of sealing, but we did get some water flowing back out of it that we have begun monitoring.

We do also -- I didn't mention it before -- we also monitor this portal that was sealed on the east side, which has always been dry. We've never encountered any water flowing out of that east side, which would indicate that this is probably not filling up with water, because if it was, you'd have water seeping out of that area.

Hopefully that'll clarify.

MR. SMITH: Yeah, that's helpful. Thank you.

MR. REYNOLDS: Other than that flow, all the flow we're encountering is coming out of here (Indicating).

MR. CARTER: Where did the other flow that was 250 gpm, then dropped off -- where was that coming from?

MR. REYNOLDS: That was coming out of this section right here (Indicating).

MR. CARTER: That's the same place. So now --

MR. REYNOLDS: Yeah.

MR. CARTER: -- it's down to 20? You pulled the pillars?

MR. REYNOLDS: Dropped down to about 22 when we pulled pillars and discontinued that.

MR. CARTER: And now you've got 18 coming out of the gob?

MR. REYNOLDS: It appears to be about 18. It varies somewhat, but . . .

Q (BY MR. SMITH) The three wells -- and this is the fourth well that was drilled?

A Uh-huh (Affirmative).

Q Why has that not been drilled all the way through?

A I really do not know the answer to that.

MR. WHITE: I can testify to that later.

Q (BY MR. SMITH) Who decided about the number and placement of wells to do these tests?

A That would be something I think Mr. White could probably discuss.

Q And your answer would be you don't know?

A No.

Q I'm not trying to get you to answer questions for other people. All you have to say is, "I don't know," and then we'll move on to something else.

A I just didn't want you to think nobody was going to answer it.

I think it's important to note, too, that there are three separate and distinct potentiometric heads in the Star Point Formation. If we were communicating between those three sandstones, they would have the same head and not different heads.

Q Were these sandstones about the same thickness?

A They varied but they're close -- within 10, 20, 30 feet.

Q How about the shale?

A Are they the same thicknesses?

Q Uh-huh (Affirmative).

A Not exactly.

Q For example, was the same thickness found at DH-3 as DH-1 of the member of the shale or was it found to be different thicknesses at each point?

A Within -- within tens of feet. I would say plus or minus 20 feet.

Q And how thick are these, generally, these Mancos Shale tongues?

A At this location?

Q At this location.

A At the moment, I cannot recall, but we can measure them. Fifty to eighty feet thick. But that's not an exact number.

Q Have you spent any time on the issue of the pump, when water was pumped? You've heard earlier testimony today about when the water was pumped into the worked-out areas of the mine. Have you spent any time on that issue?

A Not to date, or not really at all.

Q So that's not something you're prepared to offer any testimony about?

A Huh-uh (Negative).

Q Do you know whether the fault that Birch Spring water comes out of is connected with either of these major faults that are shown on this Exhibit 8 --

A All I know.

Q -- the Blind Canyon Fault?

A I'm sorry.

Q I'm trying to make sure we're getting a good record.

The Blind Canyon Fault.

A All I know is that the fracture the Birch Springs issues from in that area is parallel to those faults. I don't know what it does farther to the north a great distance.

Q I see. So you don't know if it connects to the Blind Canyon Fault or not?

A Not -- I -- I do not know that.

Q Okay. How about these two faults that you show as the -- one of them's Blind Canyon Fault and the other one's a fault that basically parallels that? Are they connected by fracturing or faults that go back and forth between those?

A I would assume that there are fractures that exist in the rock between those two faults, as there are between the Bear Canyon and the Blind Canyon Fault.

Q And I take it the Bear Canyon Fault, where the Bear Canyon Spring is, do you know -- how close does that fault come around, or that fault is not close at all?

A It's at least a quarter of a mile away.

Q Now, going back to this exhibit, when you say there are three different potentiometric surfaces, does that mean you found water at three different places, or tell me -- because I have to admit I'm a little bit confused when you say "potentiometric surface" doesn't mean you find water there.

A Right. If I'm drilling through this -- if I'm drilling this hole -- this is going to be difficult -- if I'm drilling this hole (Indicating) and I'm in this shale (Indicating), I am not hitting this water (Indicating). Does that make -- I am not going to encounter this water (Indicating) until I move in the Storrs member.

MR. CARTER: I know this is a great oversimplification, but is it fair to say there are something like three different pressures --

THE WITNESS: Yes.

MR. CARTER: -- I mean, in terms of millimeters of mercury above sea level?

THE WITNESS: Yes, psi.

MR. HANSEN: I think to explain this as a layman, if that would help -- I didn't understand that; now I do, if you want me to give it a shot. If you don't, I won't, but I think I could clarify it in laymen's terms.

MR. SMITH: Why don't you go ahead.

MR. HANSEN: I'm just offering to --

MR. CARTER: This is informal. I like this. Good. Good.

MR. HANSEN: Our experts can correct me if I'm wrong. Picture this, that we have a tank of water sitting here --

MR. CARTER: This will be a --

MR. HANSEN: -- and it's buried in the sand, okay? So this is all sand out in here (Indicating). And suppose we have a pipe that comes out of this tank that comes this way (Indicating) and is sealed off, okay?

Now, if we were to take and drill a well here, you drill a well down to here, you find nothing; you drill the well on down to here, it's still dry; you drill the well and tap onto this pipe and the water's going to rise to this level (Indicating) -- that's the potentiometric surface. There's no water anywhere in here. Is that accurate? Does that explain it?

MR. SMITH: It's what I understood, so I guess I'm as smart a layman as you are.

MR. HANSEN: That's the difference between the water table and the potentiometric surface.

Is that -- Erik? Yes.

Q (BY MR. SMITH) So that leads me to my next question: Where is the water table in this area?

A Well, the water table describes that area where it's unconfined, which means where there's no potentiometric surface, there are potential -- pressure potential. At this point, this is the groundwater surface for the Panther Sandstone member, from here on out (Indicating). From here, this is the potentiometric surface (Indicating). This was all saturated (Indicating); this is not (Indicating).

Q Now, why are the lines -- I mean, you say the line goes from the Panther potentiometric surface, goes up, you take it into the Storrs, then you stop it?

A Well --

Q Why doesn't it just continue on up into the Blackhawk Formation? I mean, that's where the recharge has got to come through.

A No, it doesn't. As I think I've testified several times, this is not a groundwater service. The water is in this formation; it's not up here (Indicating). This line does not represent the water surface, an actual water table surface (Indicating).

Q I understand that.

MR. CARTER: It's the pressure surface.

Q (BY MR. SMITH) I understand that's where the pressure is. I guess what I'm trying to say is -- why do you take it through the one and then stop it here? is what I'm trying to say.

A Well, we have this point (Indicating) that we measured, the potentiometric surface --

Q Okay.

A -- in this well, but we have no --

Q Oh, you just don't have the information for this? Is that what you're saying?

A Well, the end of the mine is here (Indicating).

Q But this well could have drilled more, then continued this?

A Oh, yeah, but there's no reason to believe at this point that it's going to suddenly pop up.

Q Okay. Now, the Panther Sandstone is just -- how much did you say? -- about 100 feet thick? Is that how thick that is?

A Well, let's pick a hole here and maybe I can tell you.

Q Why don't we talk about how thick that is.

A It's about 100 feet.

Q Okay. And --

MR. HANSEN: Just for clarification for the record, where are we getting this information?

THE WITNESS: This is coming out of the hydrogeologic evaluation portion of the PHC.

Q (BY MR. SMITH) All right. So if it's that

thick -- and where does its recharge come from?
A Somewhere other than the permit area.
Q But you don't know where?
A I could not put my finger on it, no. The reason I say that is because, again, the vertical permeability in this area is so low.
Q And even if it were out on the surface somewhere -- do you know where the Panther Sandstone is on the surface?
A All along the face of Huntington Canyon.
Q But that's a vertical there. It can't get much water through that, can it?
A Where streams and creeks cross it, yes.
Q And where is that?
A Anywhere you see a stream and creek crossing the Panther Sandstone on that map. That's a -- but that's not to say that's exactly where it's coming from.
Q Well, in Birch Spring we have --
A -- 1,500.
Q -- 1,500 years old --
A Whatever it is.
Q I guess we'd just have to leave it: You don't know whether it's recharged through the Panther Sandstone?
A I cannot say that without some significant

studies being performed.

Q And do you know where the water that's being pumped out of the mine -- where it would go without the mining?

A If the mine was not there?

Q The mine was not there.

A Really couldn't say.

Q Really couldn't say.

MR. SMITH: Thanks. That's all I have.

MR. CARTER: Okay. Jeff has one more.

MR. APPEL: Two.

MR. CARTER: He has more, too, or is this for us?

MR. HESS: They've made the statement several times that water is transmitted horizontally many times greater than vertically. Can't we use a slope gradient and start at the point where the water's coming out and draw -- use that slope gradient to establish where that surface precipitation is penetrating through the ground?

MR. CARTER: This probably is a graph exercise, but the -- I mean, you could say, if it's an order of magnitude, then 10 feet vertically is 100 feet horizontally and it's two orders, it's 10 and 1,000.

MR. HESS: That's going to give us an approximation.

MR. CARTER: Except it wouldn't follow a linear path, right? I mean, these guys are the experts.

THE WITNESS: That would work if it was a homogeneous situation.

MR. CARTER: Right. Thanks.

FURTHER EXAMINATION

BY MR. APPEL:

Q The wells that you drilled, including SDH-1 -- which of these wells attempted to determine if there was water in the Blackhawk Formation?

A I would -- since I was not there when they drilled it, I would assume that they were looking for water when they started in the Blackhawk Formation. I guess -- what I'm saying is, as soon as they spud the hole, I'm sure they were looking for water. And they spud within the lower Blackhawk Formation.

Q But did they do any tests the way they did in these other sequences?

A Not that I'm aware of. Permeability or slug test?

Q Yes.

A There was no water there, so they couldn't.

Q Obviously, they didn't run into a sandstone channel?

A Now, they could have. It just didn't have any water.

Q Okay. Now, you mentioned -- let me just back up -- that studies will be necessary to determine the recharge area. If you were to design studies to determine what the recharge area was that Mr. Smith was discussing, what would you do?

A I would probably ask a hydrogeologist to do it.

Q What, based upon your knowledge, would you suggest?

A I'm not sure I'd feel comfortable answering that, simply because I'm not here as an expert on hydrogeology but more as geologist.

Q What are you here as an expert for?

MR. HANSEN: I think that's been his entire area of testimony.

Q (BY MR. APPEL) What would you call yourself an expert in?

A Probably the stratigraphy and structural geologic interpretations of this area.

Q Okay. In any event, in order to determine where the water actually comes from, you need additional studies, in your estimation?

A If that was important, yes. I think for this hearing what's important is whether or not the mine is in the recharge area.

Q In any event, that information is not in the PHC?

A I think it is. I think that the statement that the mine is not within the recharge area is in the PHC.

Q I'm referring to the studies you alluded to --

A No.

Q -- in response to Mr. Smith's question.

A No, there are no additional studies we haven't already discussed.

MR. APPEL: Okay. Thanks.

MR. CARTER: I would -- to take this back to what I think the statutory obligations of the Division are -- well, that's okay. I think the very narrow question really is much more prosaic, and that is, Are these mining operations causing diminution, interference or -- the other word --

MR. HANSEN: Contamination.

MR. CARTER: -- contamination of a water source or source of supply? And whether it's in or out of the recharge area is not particularly material to me, it seems. I mean, convince me if I'm wrong. The question is, Is this operation interfering with the --

MR. APPEL: It's intercepting the water.

MR. CARTER: And then the other question, which is, Did the Division have enough information in front of it to do it in the first place?

MR. APPEL: You just realistically answered that question.

MR. CARTER: But because there have been -- and I remember Craig saying either last time or the time before -- well, I think it was the opening argument -- saying if there was any connection, then the Division must require Co-Op to do something. I'm ready to be convinced that's true, but I don't think it's true. I think what we're looking for here is, Is the mining activity interfering with the water users' source?

And one of the things I said earlier in the day: Is a diminution of a gallon a minute interference, diminution -- I mean, does that fall -- do we need -- well, I'm repeating myself.

MR. SMITH: Let me explain why I think the recharge is important, and I think that might be helpful. Our theory is that the water that's being intercepted by Co-Op is part of the recharge water that's recharging those springs.

MR. CARTER: And they're intercepting water that would have made its way to the spring?

MR. SMITH: Water that would have made its way to the spring or --

MR. CARTER: I mean, the shorthand version is --

MR. APPEL: That supports the recharge.

MR. SMITH: You have a big bathtub of water and the --

MR. CARTER: Either it's the exact water or it's an interference with a flow system that's letting you get your water.

MR. APPEL: It's a disruption in the historic flow patterns that would have otherwise recharged this spring.

MR. HANSEN: And I think our theory on the recharge might be easier on the blackboard. Suppose the recharge area is here (Indicating). The water that gets to Co-Op Mine comes down this way (Indicating). The water that gets to the springs comes down this way (Indicating). Even if there was a common recharge area, the water that's coming this way (Indicating) would never go over there, and so it wouldn't matter.

MR. CARTER: I wanted to make sure I understood the arguments, that there was not an argument being made that just because they're in the same hydrologic system or area that they -- well, never mind. I think I understand it.

MR. HANSEN: Our point is that at a certain point, the water that is going this way (Indicating) has no hydrologic connection with the water that's going this way (Indicating).

MR. CARTER: The thornier question is, If there is some hydrologic connection, what is the quantum of that connection or the quantum of the effect of the connection that triggers a need to require something further of the operator? I mean, I think that may be a legal question you just need to brief.

MR. APPEL: And that's part of it.

MR. HANSEN: I think the determining --

MR. APPEL: I'm going to wait on this.

MR. CARTER: Yeah, we're getting --

MR. HANSEN: I understand we'll probably all submit a memorandum when this is concluded, is my understanding.

MR. CARTER: I was going to ask if you wanted to do that, but --

MR. HANSEN: My understanding of the basic -- is the Division regulation -- is the mining operation designed to prevent material damage to the hydrologic balance outside the permit area? I think that's the question.

MR. CARTER: That's one. And with the new law, we have a -- well, never mind. That's what brought us here.

MR. SMITH: I have just a couple of follow-up questions for Mr. Hansen.

MR. HANSEN: For me?

MR. SMITH: No.

MR. HANSEN: Oh, that other Mr. Hansen.

MR. CARTER: This is based on your theory of potentiometrics.

FURTHER EXAMINATION

BY MR. SMITH:

Q The question I have is, Did you do any research or any investigation, I should say, into what the cause was for the diminution of Birch Spring and -- let's start with Birch Spring. With Birch Spring.

A Yes, and I think that Mr. White will probably testify to that.

Q Okay. So do you have an opinion on this or does he have the opinion on that?

A Well, yes, I have an opinion, but for what it's worth, I guess. My opinion is, it's precipitation-related.

Q Precipitation-related? Is that the same for Big Bear Spring?

A Yes.

Q And what kind of investigation did you do?

A We compared precipitation flow rates --

precipitation amounts and flow rates.

MR. SMITH: Okay. That's all I have.

MR. NIELSEN: I had a couple of questions too.

MR. CARTER: Sure.

EXAMINATION

BY MR. NIELSEN:

Q I've been listening to this, and you said that vertical fracturing is insignificant in the Blackhawk --

A No.

Q -- only in the sandstone units?

A No. No.

Q What did you say, then?

A I said there is fracturing.

Q Okay. There's fracturing but there's not an important hydrologic connection vertically? Vertically, I mean.

A Let's back up and take this as a whole. From the top of the mountain to the Mancos Shale, the area may be fractured and your sandstones may be -- permeability may be enhanced in those because there's no mechanism for those to reseal within themselves. But the shales, claystones, mudstones, etc., seal themselves.

Q Right. The problem I'm having here: You say that but then you come down and tell me that the Panther Sandstone is significantly fractured, that it's recharging from Bear Creek Spring, or the stream, through more Mancos Shale than the thickness between -- if you look at the map --

A Where is the Mancos Shale?

Q Mancos Shale's on the side of the canyon -- in the middle of the canyon. It's cutting through a couple hundred feet of Mancos Shale to recharge the Panther, or it's got to be several miles above.

THE WITNESS: No.

MR. CARTER: I understood --

Q (BY MR. NIELSEN) The fracturing is significant in the Panther, the recharge just was not above. And I'm having a problem --

A You're talking about a location where the Panther Sandstone is exposed at the surface.

Q Well, sure. That's a mile upward.

A No, it's a quarter of a mile.

MR. HANSEN: Are we talking about just the Big Bear Spring? because the mechanisms for the two springs are significantly different.

Q (BY MR. NEILSEN) Just the Big Bear. So I was having a problem here with this fracturing thing. It's significant for the Panther but not for anything else?

A No, it's significant for any sandstone.

Q That's our point.

A The fracturing within the shales you're trying to communicate water through aren't there. They may be fractured but they'll heal. The water running across the surface of the Panther Sandstone at the creek may be entering those joints and fractures because nothing's sealing them there. But as soon as you put some Mancos Shale on top of them, you're sealing it off.

Q Okay. The other question I have is, If you review the permits of all the other mines, plus you review all of the USGS reports and all these investigations of hydrology, they consider that Spring Canyon Sandstone and the lower Blackhawk essentially to be a water table aquifer, continuous.

A Yes.

Q How come it's different here than --

A On a regional scale --

Q When I worked at the Plateau Mine, we built the --

A Let me answer your first question.

MR. APPEL: The reporter will never get this. One person ask a question.

MR. HANSEN: Is Mr. Nielsen testifying or is he asking a question?

MR. CARTER: Well --

MR. NIELSEN: It changes all the time.

MR. CARTER: -- whatever it is, one at a time.

THE WITNESS: Let me answer your first question. For the region, they're calling this a regional aquifer, and that -- on that scale, you cannot see the difference between this potentiometric surface and this potentiometric surface (Indicating), when you're looking at something that's 100 miles wide and 200 miles long. And honestly, I have a hard time calling it the regional groundwater surface.

MR. NIELSEN: Okay. We're done.

MR. CARTER: This'd be an opportune time for a break --

MR. HANSEN: I have just a couple of questions.

MR. CARTER: -- as soon as we're through.

FURTHER EXAMINATION

BY MR. HANSEN:

Q Chris, we were talking about the potentiometric surface in the Storrs Sandstone member and the Spring Canyon Sandstone member.

A I'm sorry. Run that by me again.

Q You talked about there being two different potentiometric surfaces, different surfaces in the Storrs member and the Spring Canyon member?

A They have a different potentiometric surface, at least in the mine area.

Q Is there water flowing within those two sandstone members?

A There -- is there water flowing through the members?

Q First, is there water in those members?

A Yes.

Q Is the water in those members moving?

A At some -- some rate, yes.

Q Do you have an opinion as to where that water moves to, ultimately?

A To the outcrop in this area.

Q And so where does that water come out?

A Along the face of the contact between the Mancos tongue and the individual sandstone members.

Q And what happens to that water when it reaches those faces?

A It can evapotranspirate. It can not even come to the surface but can run down through the soils, vegetation.

Q Is surface evaporation and soil absorption sufficient mechanisms to account for all the water that would be in those members?

A I haven't done a water budget, so I'm not sure I can answer that.

Q It would be consistent with your observation that it would be, though?

A From what I know, yeah.

MR. HANSEN: That's it.

MR. CARTER: I have one last question: What's the flow of Big Bear Spring today, roughly?

MR. LEEMASTER: About 140 gallons a minute.

MR. CARTER: I thought it was in the same order of magnitude as the 120-gallon-a-minute flow that we're seeing from the channel, so okay.

MR. HANSEN: When was the last time that measurement was actually taken?

MR. LEEMASTER: Today, but I don't know the results today. But we take them on the 15th of the month and the last day of the month.

MR. HANSEN: You're saying on February 15th it was -- do you remember what the exact number was?

MR. LEEMASTER: No.

MR. HANSEN: You don't know if it was higher than or lower than 140?

MR. LEEMASTER: It's been around 140 the last couple of months. I could find those if we needed them.

MR. HANSEN: For the record, that was Darrel Leemaster's statement.

MR. CARTER: All right. Thank you. Let's take a break, and so we'll be off the record.

(A short recess was taken.)

MR. HANSEN: Next witness is Rich White.

RICHARD WHITE,

called as a witness for and on behalf of Co-Op Mining Company, was examined and testified as follows:

EXAMINATION

BY MR. HANSEN:

Q Tell us what you know.

A I'd like to just be able to say "What they said" and call it quits, but I don't think that would satisfy everybody's curiosity.

I want to give you a little bit of background for those who are not acquainted with my background. My name is Richard White. I'm the president of EarthFax Engineering, have been with EarthFax since its founding. Prior to that, worked for a couple of other consulting firms in the Salt Lake City area. My experience has been largely with mining operations, conducting hydrologic assessments and evaluating the hydrologic impacts of mining operations.

I have a bachelor of science degree in watershed science from Utah State University, received that in 1976, and a master of science degree in civil and environmental engineering from Utah State in 1977. I've been involved with Co-Op Mining since -- I believe it was

1990, '91, in that time frame that we first began working with Co-Op.

The work that we've been talking about here, we were asked to assist Co-Op in the preparation of a hydrologic -- hydrogeologic evaluation and to prepare a Probable Hydrologic Consequences report in support of their permit to mine. The drill holes that have been discussed at the mining operation were part of that responsibility on this project.

I was the principal in charge of the project. The fellow who has been mentioned, John Garr, was the project manager. John is no longer with us. John was a geologist and he was responsible for the field implementation of the project. I was responsible for reviewing the data, providing general oversight of the project.

The locations of the drill holes, holes DH-1 through DH-3, those were recommended initially by us to Co-Op. Co-Op, then, agreed with those locations. We wanted to make sure we were going to be in areas that were going to be reasonably accessible for a period of time. The drilling and testing program was developed jointly by Mr. Garr and myself. As I indicated, Mr. Garr was responsible for the field implementation of that program.

Those holes were drilled, as has been testified, latter part of 1991, first part of 1992. During the drilling of those holes, we paused at various intervals to insert what are called packers into the hole where you seal off the hole within a zone in the hole and then we would allow the water levels to stabilize. We'd measure periodic water levels in that packed-off zone to assess that the water levels had stabilized and then would conduct further drilling in each of those zones. We also ran a series of tests to determine the hydraulic conductivity of the various units which were encountered.

The drill holes were then completed as a monitoring well in the Spring Canyon tongue. The regulations require that the predominance of the efforts in the hydrologic sense for groundwater be directed toward the aquifer which immediately underlies the coal seam. From our drilling program, we determined that that was the Spring Canyon tongue, that there were deeper aquifers in the Storrs and the Panther tongue. But each of these wells were completed in the Spring Canyon tongue since that was the aquifer that immediately underlined -- underlaid the coal seam that was being mined.

In 1994, as I recall, or the latter part of '93, pillars were pulled in the area where DH-3 was drilled, which meant that that hole was no longer available for monitoring, and so at that point we assisted in the installation of DH-4. And having already gathered the data on the sandstone tongues beneath the coal seam from DH-1 through DH-3, we felt it was adequate to fully penetrate the Spring Canyon tongue with DH-4 but did not see the necessity of drilling that hole deeper.

In a -- somewhat in the same time frame -- a bit later than that, as I recall -- Co-Op was involved in the drilling of some surface drill holes that are shown on the cross section of Exhibit C-7, SDH-1 and SDH-2. Those holes were also drilled down into the Spring Canyon tongue. Co-Op was predominantly responsible themselves for the installation of those holes. We have evaluated the data that have come from those holes, but we were not directly involved in the field effort into the installation of those surface drill holes.

As we have evaluated the data, it has been our conclusion that based on the drill hole data, as has been stated, I think, by several people in this hearing, that groundwater in the Star Point Sandstone tongues flows generally from the north toward the south. We saw similar pressure gradients in each of the tongues. Each of the tongues of the Star Point exhibited that north-to-south flow with generally the same type of hydraulic gradient.

The -- each of the tongues of the Star Point, as you advance to the north, were under pressure. I think -- I'm hopeful that the concept of potentiometric surface versus water table has been beat to death. But basically, as we went to the north, we found that there was a sufficient pressure that once you hit the tongue, water level rose in the bore hole to an elevation higher than the top of the tongue. And that confinement, based on the data that have been collected within the permit area and to the north in the adjacent areas as exhibited by the surface drill holes had confinement seems to be pretty much consistent toward the north.

There is an area where each of the tongues of the Star Point are under water table conditions, if you will, where the water level did not rise above the top of the tongue. That's generally the southern portion of the permit area, essentially that area from about DH-1 to the south. DH-1 itself is pretty close to that contact where things go unconfined toward the south. But generally, toward the north, it's under confined conditions.

As far as the -- where the recharge for these various tongues comes from, based on the water level data, we know that the flow is from north to south; therefore, it would appear that there's a reasonably significant component of the recharge that is northward.

Whether that's northeast, northwest, or somewhere in between, I don't know. Within the permit area, it's pretty much a straight north-to-south flow. As you get north of the permit area, where we have less data, there's always the potential that there may be some east or west component to that, but I think we can say that generally the recharge areas lie to the north.

In the work that we did as we reviewed the regulations and attempted to comply with the regulations, it is our opinion that the hydrogeologic evaluation, particularly the Probable Hydrogeologic Consequences report that was prepared back in 1993 was adequate to satisfy the regulations which were in force at that time, that those regulations require that there be a discussion of recharge and discharge areas, and we have presented that discussion.

It is not my opinion that the regulations require that you pinpoint every recharge area. Rather, the regulations require that you discuss recharge conditions. You discuss what that mechanism is. The PHC does discuss that, indicates that recharge occurs northward, outside of the permit area. And it's far beyond the requirements of the regulation to require a mining operator to continue to pursue that groundwater information until you have assured yourself of reaching that recharge area.

There are, admittedly, things that can be done to pinpoint recharge areas. We've seen, I believe -- Mr. Mayo -- Dr. Mayo indicated that the ages of the water in the channel that were encountered near the northern portion of the workings -- that those ages generally tended to be about 1,500 years. We could do some tracer studies, wait for 1,500 years only to find out that we put our tracer in the wrong spot, go to another spot, wait 1,500 years. I think all of us realize that that's a little bit beyond the requirements of the regulations.

What the regulations, again, require is that we identify what that general pattern is and that we more specifically look at the potential impacts that mining will have on the hydrologic system.

At the time that the PHC was prepared back in 1983 -- or 1993 -- excuse me -- the area of the channel that has been discussed had already been encountered. There was at least a reasonably significant amount of water that was flowing into the mine through the roof drippers.

The copy of the hydrogeologic evaluation that I've got which served as the basis for the PHC is dated April 26th of 1993. They hit the channel on April 27th, and so the actual visualization and encountering of that channel was shortly after the PHC was prepared. However, for a period of about three years, they had been in a situation where there were increased flows.

Those increased flows to the mine were discussed and we knew where those were coming in from. And as various updates to that evaluation had been made -- for instance, with the installation of DH-4 and various other bits of data have been collected -- that evaluation has been revised as necessary at appropriate times in order to satisfy various Division requests.

We looked at -- we've looked at a variety of -- at the groundwater condition within the Bear Canyon area from a variety of different angles. Dr. Mayo has talked about a few of those that he looked at from his perspective. We also with EarthFax collected a limited number of tritium samples prior to the preparation of the hydrogeologic evaluation and the PHC.

Although we don't purport to have the same expertise in radioisotope dating that Dr. Mayo does by any means, we came to the same general conclusion that water issuing from Big Bear Spring is quite young, water issuing from Birch Spring is quite old relative to the water issuing from Big Bear. We did not have the capability of putting dates on it as Dr. Mayo has done since.

We also looked at -- looked at the flow data at Big Bear Spring. The -- there's -- there's a reasonable concern, I think, that the water users have expressed with regard to Big Bear Spring in particular because our data do indicate from the drill hole data that the flow is from the north to the south and Big Bear Spring is directly south of the mining operations. And that's a reasonable concern to express.

There has been also a reduction in flow in Big Bear Spring over the last several years. And if I could -- not wanting to confuse myself with Dr. Mayo by standing up, but if I could, I'd like to stand up. This is a graph of the flow of Big Bear Spring for the period of record that's available (Indicating).

Basically, everything from the general time frame of late '81, early '82 -- that's data from the water users association that they periodically provide to Co-Op. Prior to that point is some information that we obtained from -- actually, I guess it was probably about 1980 that was in here (Indicating) that the water users began gathering their periodic flow data.

The data that are present the -- back here (Indicating) for the time frame of 1978-1979 come from a report that the USGS prepared as they were looking at hydrologic conditions in the Huntington Creek area. And they collected data from several springs in the general watershed of Huntington Creek and the surrounding areas. And that's a year or two earlier than where the water users had begun collecting their frequent data. So we wanted to augment the database.

They've correctly indicated in the past that since during the time frame that they've been collecting data that there's been a general decline in the flow of Big Bear Spring, that we do have time frames in the early '80s where it was not unusual to see peaks in the springtime that got up to 300 gallons a minute or even higher than that. Those naturally, of course, died off in the fall and you saw a -- typical annual variations in the flow of the spring that are not unusual for springs in this region.

Then they noted that beginning about in 1987 or so that there was a general decline in the flow from Big Bear Spring. And that caused some concerns because of Co-Op's advancement toward the north and their location directly south of the mining operations.

MR. HANSEN: Can we mark this as Exhibit C-10?

THE WITNESS: That works for me.

As you look at the historic database and include the information that were collected by -- the information that was collected by the GS, it's apparent that significantly lower flows in Big Bear Spring have been measured prior to the beginning of mining activities. Mining began in 1982 in the area, and so for a period of three or four years before that, for a period of about one year, the geological survey collected data approximately every month from Big Bear Spring. And it was after that time frame that the water users began collecting their, I think, bimonthly data from the spring.

This -- these two horizontal lines (Indicating) running through the graph represent the high and the low of what was measured by the geological survey back in 1978 and 1979. And so you can see that at least for the first four or five years that the water users were collecting data they were in a period of high flow. And it was quite a bit higher than -- than what had been measured in the spring a few years prior to them collecting flow data and a few years prior to the mining by Co-Op. The latter data are, with a couple of exceptions, pretty much within the range of the historic flow data if you look at the 1978-through-1979 data.

This indicated to us that there is some historical record that indicates that flows in Big Bear Spring have been measured at the low rates that -- relatively low rates that they're seeing now.

Typical flow rates generally in the time frame that the water users association started to gather frequent data -- you typically had flow rates that were around 200 gallons a minute. Those flow rates dropped down to 120 or so gallons a minute. They're up to 140 gallons a minute now.

The range of data that were collected by the U.S. Geological Survey varied from a low of 110 gallons a minute in April and May of 1978 up to a high of 165 gallons a minute in October of 1978. So this is, again, three and a half or four years before Co-Op began their mining activities.

I think it's obvious from the historical data that there's at least a historical precedent that flows in the range of what they're seeing now have historically been there, that the mere presence of low flows, lower than what they had in the mid-1980s, should not indicate that it's purely an impact from mining activities but that -- that historically they've seen -- those types of flows have been measured at Big Bear Spring.

The -- as we evaluated the data, the blue line here (Indicating) is the spring flow data. The red line is the precipitation data. And it's obvious from just looking at the general trends that we had much higher precipitation in the early to mid '80s than we've had really even since the early to mid '80s. It's been a good ten years since we had the types of precipitation in this general region that we had back in that earlier time frame.

The fact that we have very young water in Big Bear Spring would suggest that there's a reasonably close type of recharge area to that spring. That's not to say that that's the only place that it's going to be recharged. As I think Dr. Mayo pointed out and Mr. Nielsen discussed, the -- any time you try to do age dating, you're really dating the average of all the waters that mixed, and so there's a reasonable chance that some of this water is quite old. But in total, it appears that most of the water is fairly young.

You couple that with the type of response that we see in comparing the flow and the precipitation data and that would, again, suggest that this spring is fairly responsive to precipitation events, not so much individual events as more multimonth or annual types of precipitation records.

What happens when you get in a system where you have springs that are discharging, you typically -- for want of a better explanation, you essentially have this bathtub that has to overflow in order for the spring to discharge. And it's apparent that that bathtub is always overflowing somewhat because there's always water coming out of the spring.

But when you get a period of prolonged drought relative to prior seasons, it takes a while. As we start to get increased precipitation -- it takes a while to satisfy that deficit. As the water continues to flow, you're basically creating a water deficit in the system, and it takes a while for that to be satisfied.

So even though you may have fairly short responses, the early data suggested that just a period of a couple of months from peak precipitation to -- or peak flow in Huntington Creek to peak flow in Big Bear Spring was just a couple of months. Now, as we're back into that -- as we're kind of coming out of that prolonged dry period, that response is not near as rapid because you're trying to satisfy that water deficit.

We looked at Birch Spring also.

MR. HANSEN: Mark it C-11.

THE WITNESS: C-11.

MR. HANSEN: Do you want foundation? Or we're pretty informal.

MR. APPEL: For demonstrative purposes.

MR. HANSEN: Well, I think this is represented to be a graph of actual data.

THE WITNESS: I can tell you that the flow data came from the water users as they provided the data to Co-Op. And the precipitation data we obtained from five -- took the average of five precipitation gauges in the -- in the area. And so we tried to get -- rather than looking at just one gauge that, because of elevation differences out in this area, may be biased one way or another, we looked at multiple gauges and averaged that, so . . .

We didn't show on this -- on the blue line here (Indicating) -- we didn't show the data that were collected by the U.S. Geological Survey because of the -- because of the -- basically the short time frame over which data had been collected by the water users.

If we extended this graph out to the left and put the one-year worth of geological survey data on here, everything would get scrunched into one little spot and it would be hard to see. But we put -- the horizontal lines on that, again, represents the maximum and minimum flows that were measured by the geological survey at Birch Spring back in 1978 and '79. They measured a low in Birch Spring of 9.3 gallons a minute in July of '79 and a high of 23 gallons per minute in May of 1978.

As you look at the more recent data -- basically the last three or four years' worth of data that have been collected from Birch Spring -- you're very near what the geological survey reported as the peak flow that they measured during that time frame that they were evaluating the data.

Again, you look at -- you look at the precipitation data. It's obvious -- since it's the same precipitation data, it's obvious that we've had a lot more precipitation in the early to mid '80s than we had in the mid to late '90s. Those precipitation amounts are starting to pick back up. There appears to be some kind of a response at Birch Spring that's similar to Big Bear in that respect, that long-term precipitation seems to influence it.

Birch Spring is also completed differently, as I believe a couple of the representatives of the water users association have testified. Big Bear Spring comes out of a handful of discrete fractures in the sandstone. Birch Spring is basically a French drain at the base of a sandstone ledge that's been backfilled with pea gravel and perforated pipe, and is collected in that manner.

The area overlying Big Bear Spring is basically a sandstone cliff. The area overlying Birch Spring is a much flatter area, not totally flat by any means, but a much more gentle slope. Soil, various -- various phreatophytes and other vegetation that may or may not be affecting the flow of Big Bear Spring.

But it's apparent from looking, again, at the historical data that historically there have been flows out there that are actually quite a bit lower than what they're experiencing now. Those historical -- historic flows were measured three or four years before mining activities began there in Bear Canyon.

There's been a bit of discussion about the potential for recharge to occur vertically through the permit area. Various people have expressed their opinions about how tight or untight the formations are.

I looked through some information that Gregory Lines presented in a water supply paper that the geological survey prepared for the -- for the general vicinity. Most of his work was over on Trail Mountain, which is just to the southeast of where Big Bear -- where Bear Canyon is.

In the course of his investigation, he collected some samples, some core samples of rock coming out of the Blackhawk Formation and out of the Star Point Sandstone. He didn't identify in his logs, at least in the report, which tongue of the Star Point he was in, but he collected various units out of both of those formations.

Generally, the sandstones in both the Blackhawk Formation and the Star Point Formation where he collected the samples -- I should back this up. He took the samples in for permeability tests in the laboratory, ran horizontal and vertical permeability tests on the samples he collected from these cores.

Generally, the sandstones, whether they were out of the Blackhawk or the Star Point Formation, the -- the hydraulic conductivities of these units were about 10^{-5} to 10^{-6} centimeters per second. As you got into the siltstones and the shales, with one exception, the permeability -- hydraulic conductivities were 10^{-11} to 10^{-12} centimeters per second. So that's about six orders of magnitude lower in permeability, a factor of a million lower in permeability than the sandstone units.

The one exception was reported by Mr. Lines as being impermeable. They applied a pressure of 5,000 pounds per square inch to the -- to the sample, both horizontally and vertically. This was a shale sample out of the Blackhawk Formation. And they could measure no permeability even at 5,000 psi. Everything has a permeability -- I recognize that -- but it was significantly lower than anything they had tried to measure.

So we're looking at sandstone, hydraulic conductivities that, again, were in the range of 10^{-5} to 10^{-6} centimeters per second; siltstone and shale hydraulic conductivities that were 10^{-11} to 10^{-12} centimeters per second. I report these in centimeters in second. He reported them in feet per day.

But just as a point of reference, the permeability that U.S. Environmental Protection Agency's regulations require for liners on hazardous waste impoundments is 10^{-7} centimeters per second. So we're at a permeability four to five orders of magnitude lower than -- than what I would be required to put in for -- for a hazardous waste landfill.

I think that's -- that's instructive not so much that it's four to five or two to three or fifteen or twenty. I think -- I think what's instructive is that it's significantly lower -- significantly lower than that liner requirement and significantly lower than the hydraulic conductivity of the sandstone units.

These were, admittedly, laboratory samples. The laboratory sample is going to take a look at that 2-inch diameter core and the sample's going to be 6 inches long, and that's all it looks at, and there's a gazillion cubic yards of bedrock out there. But the data were relatively consistent and the data are consistent with what we see reported elsewhere in this type of a formation.

We've worked not only here in the Wasatch

Plateau but also down around the Kaiparowits Plateau, where the formations are called by a different name, but it's basically the same set of units. And we see very similar types of hydraulic conductivities.

I think that from that information and from the observations that we can make as we go out and look for seeps and springs in this area, it's obvious that the siltstones and the shales have a significantly lower hydraulic conductivity than the sandstones.

Most of the areas where you see springs issuing are near those contacts of a sandstone overlying a siltstone or a shale. That's the case at Birch Spring and Big Bear Springs, where you have the thick sequence of the Mancos Shale that underlies the Panther tongue of the Star Point Formation.

We see that frequently within the North Horn Formation, within the Blackhawk Formation, where you'll get a sandstone lens. And where there's a seep that occurs, it's often near that contact between a sandstone overlying a siltstone or a shale.

You see that in the Castlegate Sandstone, if you can find springs in that unit around the region, where they're often discharging near that contact with the Blackhawk Formation. There's just not a lot of water that passes through -- vertically passes through this sequence of formations, from what we've been able to see both here at -- in the area of the Bear Canyon operation and elsewhere around the region.

That's not to say that there's absolutely no water. I don't like superlatives. That is always a possibility, that something is going to make it through. I think that's a -- that's obvious. All things are possible. I hope we don't get into that line of questioning and arguing. I'll tell you right now that there is a possibility that some water will make it from the top of this mountain down into the Panther. It will pass through where the mine was and it will discharge at Big Bear Springs. I think the quantity of that water is extremely low. I'm not going to put a number on it, but it's extremely low.

To give you an idea of the time frame, I took the numbers, the high end of those shale hydraulic conductivities at 10^{-11} centimeters per second, and as -- and calculated how long it would take under a unit hydraulic gradient for water to flow through 1 inch of shale; it was slightly less than 8,000 years.

Water undoubtedly gets from the top of this mountain down into the Spring Canyon, down into the Storrs, down into the Panther. It occurs. But again, I think that quantity is so minuscule as to be unmeasurable. But I'm sure if we could tag some molecules and wait, we would find that they would arrive.

Where does the recharge occur for this area? It's somewhere to the north. I don't know if it's northeast, if it's northwest, if it's straight north. Within the area that we have data, the flow is generally north to south. As you get outside of the area of where we have data, we may find that it's slightly trending to the east, to the west. But the recharge area is northward.

I think that given the low permeability of the shales that are present out here, given the fact that these shales tend to be less brittle, that if fractures occur, they tend to heal themselves, there's a very low likelihood that a significant amount of water is going to be percolating from within the permit area down into the formations surrounding the coal and into the aquifers that are immediately below the coal.

Also, if you look at the -- just look at the topography -- I'm looking at Exhibit C-8 -- the permit area sits basically beneath a ridge line. And so adding to the fact that these -- that the subsurface formations tend to be low permeability, you've got the steep slopes, so any water that melts, falls as rainfall, or falls as snowfall and subsequently melts is going to run off relatively quickly and have limited opportunity on those steeper slopes to recharge.

As has been stated here by others, and as I recall in my reviews of various geological survey reports, most -- that the most likely area for recharge is someplace where a formation of outcrops and the slope is relatively shallow. I don't know if that recharge occurs predominantly in Huntington Creek, predominantly in Tie Fork, predominantly in Bear Canyon.

All of those areas have full sections of each of the tongues of the Star Point that outcrop the -- there are joints and fractures that are very common in those sandstone units. Especially as you get near the surface, those joints and fractures become more common. It's reasonable to assume that there's a reasonable amount of recharge that's occurring in those areas.

For the purposes of the PHC, we felt that the regulations were satisfied to indicate that recharge is to the north and outside of the permit area, outside of the adjacent areas, and that it was not the responsibility of Co-Op to pinpoint an exact location.

I think that's also -- there's been a bit of discussion about potentiometric surfaces and water table surfaces. What -- what Chris Hansen identified as being a coincidence that this potentiometric surface in the

Spring Canyon tongue happened to intercept the mine workings at about the location of the sandstone channel that's up in the Blackhawk Formation -- I will echo Mr. Hansen's opinion that that is coincidence. This potentiometric surface line is measuring the potentiometric surface in the Spring Canyon tongue, not in the Blackhawk Formation.

We did not encounter significant water in drilling until we hit the Spring Canyon tongue. This is not representative of a potentiometric surface or a water table in the Blackhawk Formation.

As to where that water in that -- in that sandstone channel goes, I don't know. I think that there is a very high likelihood that it does not go to the south. If it was going to the south, then I should have encountered water significantly before we got into the channel. At least it does not go as far south in significant quantities as Big Bear Spring; otherwise, from the beginning of mining we should have been seeing something at least much earlier than we saw it.

We went through and did some calculations just to make some assumptions and see what would happen if that was the case; if water from that channel was destined to discharge at Big Bear Spring, where should I have run into that water and if I'm dealing, in fact, with a water table condition out here. In other words, where I hit the potentiometric surface in the coal seam, is that where I'm going to run into water in the mine.

So we looked at the flow of Big Bear Spring. And generally, again, back in the early -- back in the mid-'80s, you're looking at a flow of around 200 gallons a minute or so -- not worrying about the peaks -- but you're looking at a base flow of around 200 gallons a minute. And then that eventually got down to a flow of around 120 gallons a minute -- some days higher, some days lower. But we went from 200 down to 120. That's a 40 percent decrease in the flow.

Hydrogeologically, the only way that that can occur, if all other things are equal -- if my recharge to the system is equal, there's been no other perturbations around that have affected me, then that can only occur if I've had a decrease in head, because the flow is equal to the hydraulic conductivity times the head times the area. My area stayed the same. My hydraulic conductivity hasn't changed. So I would have to change that gradient.

And so taking Big Bear Spring as the down-gradient point and taking the mine face of the -- at the channel as the up-gradient point, we had a distance of about 9,500 feet. The mine workings at the face are at an elevation of about 7,550 feet. The elevation of Big Bear Spring is at about 7,120 feet. So there's a 430-foot difference. So based on that 430-foot difference and the distance of 9,500 feet, I said if this is one big water table system that's contributing there, we would have a hydraulic gradient of 4 1/2 percent.

Now, assuming that this water has been impacted by -- that the flows at Big Bear -- that the decrease in flows is due solely to the mining operation, that it's a result of impacts near that channel -- of course the flows started to decrease before they got into that water, but assuming that all that water came out of the channel, that that water would have all eventually made it to Big Bear either directly or, as I think Mr. Appel pointed out correctly, it could be just because of a release in pressure, that that pressure wasn't there anymore to push it out.

But making that assumption, accounting for that 40 percent decrease, that meant I should have had a head that was 40 percent higher initially before I started mining. That would have put me at an elevation 720 feet above Big Bear Spring at the channel.

So if I connect that point and I come back here (Indicating), instead of running into it here at the floor, I now would have run into it 720 -- actually about

300 -- 290 feet higher. And I draw a point back to Birch Spring and I say that's my water table premining, then I should have run into significant water at about DH-1-A, and I didn't. We didn't run into water until we got back here (Indicating), in what's been described before as the wet area, which is basically back here around DH-4.

So essentially, about a -- about a mile or so further to the south, Co-Op should have been running into significant water if, again, the reduction in flow at Big Bear can be totally ascribed to the loss of water -- to the interception of water in the mine by -- at that sandstone channel.

Based on that, based on the other evidence concerning recharge through here, based on our sampling -- on Dr. Mayo's sampling, I would have to agree with the opinions that have been expressed by others that the -- that there is a minimal potential for the Big Bear Mine to adversely impact Big Bear Spring and Birch Spring.

I think that given the historical data that indicate that historically, flows have been there, given the apparent response of the spring to precipitation, I think that Dr. Mayo's calculations concerning slightly over a gallon a minute may well be in the ballpark. If there was any impact, I think -- I think he emphasized the fact that that's merely 1.2 gallons per minute that are discharging out of that channel.

Where it's discharging from, we don't know. We don't know if it's going to Big Bear Spring. As I've indicated: very low likelihood that it's flowing anywhere to the south; reasonable likelihood it's not flowing to the west, because right near that -- that channel the fault is dry on the west; reasonable chance that it's not flowing to the north, because the general gradient is to the south. That leaves us somewhere westward.

MR. HANSEN: Eastward?

THE WITNESS: Eastward, yeah. We go far enough, we get back -- you got to go 2,500 miles to do it. Eastward. Where it goes after it goes eastward? I don't know. But I think the numbers indicate to me that it's not going to Big Bear Spring, that the -- that Co-Op's activities at the mine have not contributed to -- to impacts to Big Bear Spring or to Birch Spring.

I think that's about it. That's essentially my spiel.

MR. HANSEN: I don't have any further questions.

I did do a quick calculation on permeability of the shale. If we're talking about on the order of 1 inch per 8,000 years, that translates to about 2 million years to go through 20 feet of shale. Pretty impermeable.

MR. CARTER: I understand the argument to be that it's not the shale, to the extent there's permeability; it's fracture permeability, as opposed to permeability of the shale. But then the --

MR. NIELSEN: Yeah, there's no argument over the shale permeability.

MR. CARTER: The counterargument to that would be that the fracturing of the shale, because of the potential of the clays and the relative plasticity of the shale is less, even if you had a fracture that went through shale and sandstone, there's higher possibility that the fracture in the shale is healed than in the sand.

Is that -- I -- let me ask one question of anyone. I don't think I'll ask Co-Op's experts because I think I know what their answer will be. But if not a drop of water had been encountered in this mine, would you still believe that it is in the recharge area, the path of recharge of the spring, if it were absolutely bone dry?

Where I'm headed with this is, the testimony seems to be that all the water is coming out of the channel. I'm just saying that there's 18 or 20 gallons a minute -- that wasn't specifically testified to -- have been witnessed to have been coming out of the sand, but it's coming out of the north end of the mine. I suppose it could be coming up through the floor, but, I mean, not -- not that you have to answer on the spot, but if you got an answer, that's great.

Because I think -- my concept here of the theory that the mine workings have interfered with recharge is that the mine lies in the path of water that is -- I mean, one of the -- that the mine lies in the path of water that's moving to the spring and intercepting it and carrying it someplace else.

In the other instance, the mining we talked about this last time -- the mining and the related subsidence and fracturing and so forth have altered the flow pattern in the vicinity of the mine and therefore adversely affected the spring. But in terms of the mine itself being in the path of the recharge, it would seem to me that if the mine had been bone dry, that would not be a concern.

MR. APPEL: But we know that it wasn't, so I'm wondering why that's pertinent. I'd be happy to try to answer that.

MR. CARTER: Well, I think the geometry is something at least I had not considered; maybe my hydrologists had.

But if you try -- draw -- if there were a homogeneous substance with a preferential permeability horizontally that was even one or two orders of magnitude higher than its vertical, you could drop a drop on the top and then trace its path and say it's going to go right here.

And then you could look at your vertical distances between the channel, or the source of the water in the mine, the spring, the horizontal distances -- you know, maybe the north end of the mine is in the path but the south end isn't.

MR. NIELSEN: Yeah. Yeah.

MR. CARTER: And charting curves of flows -- this is new to me anyway. Maybe the hydrologists for the Division have thought this all through. It seems to me if it was six orders of magnitude, that's a very flat curve. I mean, the water would have to go a whole long way.

MR. NIELSEN: We're not saying that the shales are permeable. We're saying that there's more vertical permeability.

MR. CARTER: That they're traveling along?

MR. NIELSEN: Yes, for various reasons.

MR. CARTER: No, I understand.

EXAMINATION

BY MR. APPEL:

Q Mr. White, are you with me?

A I am. Maybe I can sit over here so I can see you.

Q That'll work better.

Who from your office participated in the drilling in 1991 to '92?

A John Garr was in charge of that program. As I recall, Tony Magliocchino also was involved.

Q Were they there the entire time?

A I believe they were.

Q So they didn't tell Co-Op what to do and then leave?

A No. No. I mean, whatever time they weren't there was go to the surface and get a drink of water. But yeah, they were there constantly.

Q I'm not sure: Did they attempt to measure the water in the Blackhawk Formation?

A Yes. My understanding -- my recollection is that they -- they went in to identify water wherever they encountered water and did not have a preconceived notion as to where they would or would not be encountering water other than -- I would have to look back at some old notes to see if he even discusses it. But there was probably a suspicion, looking at where springs occurred and whatnot, that there would be water in the various Star Point tongues, but that was not the total focus of the drilling program.

Q Do you know how far they penetrated into the Blackhawk in each of these wells?

A Whatever that distance is -- we can measure it if you like -- whatever that distance is from the bottom of the Blind Canyon Seam to the top of the --

Q Would it be in the PHC?

A Probably. I can measure it right now.

Q I just need to know where it is.

MR. CHRIS HANSEN: Hydrogeologic evaluation.

THE WITNESS: Yeah. There's logs. If it's critical to you, we can get you --

Q (BY MR. APPEL) Is that part of the PHC?

A It's part of what got submitted, if you have a copy -- I haven't got a copy.

Q Just answer my question: Is it part of the PHC?

A If you will provide me with a copy of the PHC, I will tell you yes or no.

Q You don't have a copy of the PHC in front of you?

A No, but I'm sure you do.

Q I'm not tying to trip you up. I'm just trying to figure out --

A Well, then why don't you provide me a copy of the PHC?

Q Why don't you relax?

A Why don't you?

To my recollection, Mr. Appel, it is in the PHC; however, I cannot quote you the page.

Q Okay. And if water was measured or not measured in your drilling activities in the Blackhawk Formation would that be in the PHC?

A To my recollection. I would like to look at the PHC, but to my recollection.

Q I'm only asking you to the best of your recollection.

A That's the only way I can answer.

Q Did you testify that you found more pressure in the Star Point Sandstone layers as you moved to the north?

A That -- yes, in the sense that the potentiometric surface rose as you moved to the north. That's correct.

Q So you measured higher pressure to the north?

A Yes.

Q And lesser to the south?

A Yes.

Q Where did you start to notice a lessening of the pressure in the drill holes --

A Well, as each --

Q -- toward the south?

A Yeah. I mean, as each hole was drilled, the hole was surveyed so we had an accurate horizontal and vertical reading on that. We knew what the elevation of the hole was. Then we could -- measuring from that point, knowing what that elevation was, we could then compare what we were finding in other holes.

Exactly the time that -- that somebody said, "Aha, it's flowing to the south," I don't know. But as the data were collected and -- initially as you're drilling the hole, everything is done relative to depth from surface. And at that point when the survey data were collected and we then had a chance to correlate the depth data to elevation -- and at that point we would have seen that there was a flow to the south.

Q I guess I'm asking you if there are measurements in the PHC that support a lessening of -- I'm going to call it hydrostatic pressure.

A Maybe we're having a semantics problem, but the PHC indicates that the flow was to the south. As I recall, there's a potentiometric surface map that indicates that the flow was to the south, and so that is what indicates that there's a lessening of pressure, if you will, to the south.

Q Because it's being released somewhat? The water is being released somewhat?

A Well, sure. I mean, if the flow was to the south, ultimately, as you get on the south end everything outcrops, can't go any further than that outcrop. So somewhere on that southern end, things are no longer -- they can't move through air, so . . .

And we would have noticed also during the drilling program -- as we did the water level measurements, we noticed that, as I recall -- and I'd have to look at the logs -- but as I recall, holes were drilled in the order that they were numbered. And so a hole that was drilled further to the south would have been -- we would have noticed that the water level is not rising above the top of the sandstone. Holes further to the north, we would have noticed that it is rising above the top of the sandstone. So from that data, it would indicate to us that there was some pressure to the north. But again, we had to have the elevation data to actually draw that potentiometric surface.

Q So as you move to the south, the water is being released somewhere?

A Yes.

Q And you testified that you did not look outside the permit area to determine recharge in the PHC?

A Outside the permit and adjacent areas. That is correct.

Q How do you define "adjacent"?

A I'd have to go into the PHC to give you a number, but basically it's defined as the area that is reasonably likely to be impacted by mining operation.

Q You mentioned two dates, April 26th -- as to when the report was, I guess, submitted in 1993, the PHC report; and then you testified that to your understanding, Co-Op hit the sandstone channel the next day?

A Yes. I think I indicated that the hydrogeologic evaluation report -- the date on that report is April 26th. And so there were some -- the -- although we discussed the increase in flows to the mining operation, because those had been encountered back in 1990 -- we discussed that in the report, but my recollection is that the initial hydrogeologic evaluation in the PHC did not specifically address the channel because it hadn't been encountered at the time it had been written.

Q And you also testified that for three years prior that the mine had been experiencing increased flows?

A Right.

Q Do you know what material they were mining then? Was it simply coal?

A Yes, other than, you know, occasional shale stringers that may have been in the coal, but yeah. Yeah. They were concentrating on the mining of coal.

Q Do you know how many feet of coal linearly they removed before they got to the sandstone channel in those three years?

A As I recall, that wet zone -- we can measure it off one of those exhibits -- but as I recall, that wet zone was about 1,000 feet in length, and, of course, they had several panels that were driven in that length; so total length of the mining would have been that 1,000 feet times all those panel lengths times that number of panels.

Q How did the water move from the sandstone channel boundary through that 1,000 feet of coal?

A Well, it didn't. I think what's been testified to, perhaps not clearly enough, is that basically this channel is a -- there's an overbank portion very equivalent to a flood plain, if you will. And so that -- that overbank portion extends over the top of coal.

And the increased flow that they were getting was coming out of the roof as they would drive roof bolts into the roof and out of, you know, fractures and whatnot in the roof. But it was coming out of that overbank portion, not out of the main body of the channel itself. They hadn't hit that yet. So it was mainly the roof leaks that were --

Q And what information or data do you have, indicating the extent of that overbank, which I presume you're saying is sandstone as well?

A Right. Right. That's based on the -- based on the flow data, based on the information that the roof bolters would gain as they drilled those holes.

Q Did you review that information?

A As I recall, we did, yes.

Q Has anyone mapped the extent of that overbank deposit?

A Not that I'm acquainted with.

Q That wouldn't be expressed in the PHC either?

A Not that I can recall.

MR. CARTER: Wouldn't the light blue area on Exhibit C- whatever was --

THE WITNESS: That's the area we're talking about. And I think what Mr. Appel is asking is if we specifically went in and mapped sandstone deposits, which I don't recall that we did. We did note that there was increased water inflow, but I -- I don't recall there having been a map generated of those sandstone deposits.

Q (BY MR. APPEL) You theorize that it is an overbank sand deposit, though?

A Yes.

Q Do you know the thickness?

A I don't.

Q A couple of times you said "USG" and a couple of times "GS." Is that the same thing?

A Same thing.

Q So it's one set of measurements from USGS?

A Yes. I may have also said "geological survey," which would be the same thing also, so -- there is a Utah Geological Survey, but . . .

Q Answer the question.

A No, this is all U.S. Geological Survey.

Q As you sit here today, do you believe that the mining of this mine has had no impact on Big Bear Springs?

A I would say that it has not had a measurable impact. Again, all things are possible.

Q You mentioned you reviewed data -- no, it wasn't USGS -- five precipitation gauges. Can you tell me where they were located?

A I'd have to look through the reports, but --

Q Generally. I don't need a metes and bounds.

A In the area -- I mean, I can give you

locations, but it's in the watershed area of basically Huntington -- the larger Huntington Creek watershed.

Q Who was responsible for maintaining it?

A They're maintained by various organizations. As I recall -- didn't ask too many specific questions -- I'd want to look at the data. But as I recall, a couple of them were maintained by Utah Power & Light. I believe the Forest Service maintains one. I think Co-Op maintains one. There were a few different entities that were responsible for the data.

Q What's the farthest one away from our site?

A Let me find the data.

Q Okay. And if anybody out there knows, it would sure speed this process.

MR. NIELSEN: I think it's the Mammoth/ Cottonwood site.

THE WITNESS: Okay. There's one at Electric Lake, so that would be ten miles up the canyon; Hiawatha, which is going to be probably about five miles to the northeast; Stewart Ranger Station, which is, as I recall, just up -- slightly up Huntington Canyon; Red Pine Ridge. Can't recall off the top of my head. Mammoth/ Cottonwood is just, I believe, to the north -- to the west five or six miles, something like that.

Q (BY MR. APPEL) Do you know if Lines took into account the change in permeability for jointing and fracturing and faulting in the area, or did he simply do his measurements for permeability on the rock itself?

A On the samples that he did the lab permeabilities on, he did whatever that rock was. There was no indication in the report that those rocks were -- those samples were fractured. To the best of my knowledge, if there was -- if there was any fracturing in those samples, it would have just been microfractures that -- that were not terribly significant.

Q So his conclusions would not take into account water movement because of associated jointing, fracturing, and faulting?

A In that -- in those samples, that's true. He did some other evaluations. He did -- he developed a model, a numerical model, groundwater flow model for the area. And in that model, it had to make some assumptions about the gross permeabilities of the Star Point Sandstone and the Blackhawk Formation.

And in making those estimates of the gross permeabilities, he accounted for the fact that much of the rock out there is -- or that at least some of the rock out there is of a permeability that was higher than what he measured in his core samples.

As I recall, he had numbers that were -- if I can convert them to centimeters per second, he had numbers on the order of about 10^{-4} and 10^{-5} centimeters per second, whereas the lab data indicated that the sandstone permeabilities were 10^{-5} to 10^{-6}. So he increased his permeabilities by about an order of magnitude as he developed the model.

Q Okay.

A He also -- just -- excuse me.

Q You testified to certain thicknesses of Mancos Shale. Do you know if they're continuous bodies?

A Yeah, I don't believe I did testify about how thick they are.

Q Of the existence of various thicknesses?

A They exist.

Q Okay. Between the two faults that we've discussed primarily today, the major ones that are in the permit area --

A Uh-huh (Affirmative).

Q -- do you know if they're continuous bodies throughout?

A I would certainly hesitate to testify as a geologist, but that is my understanding, yes, that they are laterally continuous within the permit area.

Q Do you anticipate that they would vary in thickness throughout the permit area?

A Oh, certainly to some degree. In the drill hole data we have, there was some variation of thickness of a few feet from point to point.

Q And they could be nonexistent in certain places?

A As I've said, all things are possible. I think that given my understanding of geologic conditions, which, again, I would not want to present myself as an expert in, but given my understanding of the depositional conditions under which those formations were formed, it's -- it would be very unlikely that there would be a discontinuity within the permit area.

Q But you can't rule it out?

A No, not at all.

Q Do you know when the mine reached the approximate location of DH-1 as far as mining?

A It's on the map. As I recall -- I'd have to look at it, but it would have been mid-'80s: '86, '87. As I recall, Charles would be much better qualified to give you those dates.

MR. APPEL: That's all I have.

MR. CARTER: Craig?

EXAMINATION

BY MR. SMITH:

Q I was going to ask you some questions, make sure I understand some things. Now, which formation did Birch Springs discharge from?

A Birch Spring?

Q Yeah.

A It comes out of the base of the Panther tongue of the --

Q Is that the same as Big Bear Spring?

A Yes.

Q And what formation does water in the Bear Canyon Mine -- what formation is it intercepting water from?

A That's in the Blackhawk Formation.

Q And do you have a position on the regional aquifer question?

MR. HANSEN: That was the question --

THE WITNESS: No.

MR. HANSEN: -- to which Dr. Mayo responded.

THE WITNESS: No, I don't. I don't care for semantics, so . . .

Q (BY MR. SMITH) So you don't have any position at all on it? Is that your answer?

A That's my answer. I know what we found at this site. And I -- it's a semantics issue to me. And I don't --

Q Get away from the semantics issue. What did you find at that site?

A Well, as we, I think -- several people have indicated, as we drilled the holes, found different potentiometric surfaces in each of the tongues of the Star Point Sandstone, that -- found that these -- that the tongues were -- that the sandstone tongues were hydraulically distinct, that they were not hydraulically connected. If that was the case, we would have been seeing similar water level elevations in each of those tongues, which we didn't. And so there are, beneath the -- beneath the Blind Canyon Seam in the Star Point Sandstone, there are three separate and distinct groundwater systems.

Q Okay. Is it your testimony the perched aquifers are hydraulically isolated from aquifers --

A From our semantics problem?

Q -- in the area of the Bear Canyon Mine?

A In general, yes. I mean, by definition, "perched aquifer" is something that is -- that is hydraulically separated. There's a -- there's a certain distance of unsaturated material beneath that perched aquifer and some other groundwater system, so yeah, they would be distinct.

And there's -- that's not to say that -- that there might be two perched aquifers that are nearby one another, that one may be flowing off the edge and onto another. But the -- again, looking at the relative low permeability of the shales, the discontinuous nature of the sandstones in the Blackhawk Formation, the sandstone channel being a -- an obvious example, it's apparent that there are -- that where these perched aquifers occur, they are distinct and that it is not unusual for them to be hydraulically discontinuous.

Q Okay. Do you consider the Panther tongue to be a perched aquifer?

A No.

Q How about the Spring Canyon Sandstone? Do you consider that to be a perched aquifer?

A No. And I don't want to get into another semantics discussion. Obviously that is unsaturated material below them. There's a -- there's a nebulous distance out there where people say, "This is perched. This is not perched."

Within the permit area the tongues of the Star Point Sandstone appear to be continuous, appear to be -- from the data that we've selected, appear to be saturated within the permit area. Somebody could argue semantically that they're perched because there's some unsaturated material beneath them, but they're sufficiently laterally extensive for the purpose of the permit area that I wouldn't call them perched.

Q Can you tell me where the recharge area is for the Spring Canyon Sandstone?

A Northward.

Q Is that same true --

A Northward.

Q -- with the Storrs?

A Yes.

Q Anything more precise than that?

A I can't tell you.

Q How about the Panther?

A Northward.

Q How about Birch Spring?

A Well, obviously it's a -- discharge is from the -- from the Panther tongue of the Star Point Sandstone, and so there is a reasonable chance that there's recharge coming northward.

Q And that would be the same with Big Bear Spring?

A Yeah. The -- again, the data indicate that Big Bear -- the water that discharges from Big Bear is much younger water than the water that discharges from Birch Spring, which indicates that there is a relatively recent component to the flow that -- which indicates that Big Bear occurs probably relatively closely to its recharge area. And so it's -- it's reasonable for me to conclude that the fractures that are in Bear Canyon as surface water flows across those fractures, that that could reasonably contribute to the flow at Big Bear Spring. And so in that case you're looking at northeast ward but still northward.

Q And that's as precise as we can get, I take it?

A That's as precise as I can get right now, yes.

Q Where's the recharge zone for the water that's found in the mine?

A In the channel. Is that what you're talking about?

Q Let's talk about whatever water's found in the mine. The channel's a new thing we learned about today.

A Well, I'll talk about the channel. If you've got other areas that you want to --

Q Let's talk about the channel first.

A Okay. It's -- it's -- in my opinion, probably it's not southward.

Q Okay. Anything more precise than that?

A No. I would -- no, I really can't at this point.

Q How about water that's not in the channel?

A I'm not sure where you're talking, so that's what I -- I thought I'd better confine myself to the channel.

Q Maybe I can ask a couple of questions and clear this up. Is there water in the mine that's not coming from the channel?

A Not that I'm aware of.

Q So all the water in the mine's coming from the channel?

A Currently that's the case. Yes, that's my understanding.

Q Is the channel discussed anywhere in the PHC?

A I thought we've been there.

Q Just want to be clear about this.

A As I indicated in my direct testimony and in my discussions with Mr. Appel, the PHC was prepared shortly before the channel was intercepted. There was increased flow to the mine at that point. We've discussed that increased flow. But I do not recall -- although I'd have to read the PHC to refresh my memory -- but I do not recall that the channel is specifically discussed in the PHC, because it was prepared just prior to that channel being encountered.

Q I take it that's a long way to say no?

A Well, I kind of felt like saying no the third time wasn't going to answer your question, so I thought I'd better use a little bit longer sentence and hopefully get the question answered.

Q Okay. Is the coal seam in the location of Trail Canyon Mine -- well, I guess -- is there -- we've talked about -- is there a water table? Can you define where the water table is around --

A You said "Trail Canyon." Are you talking about Bear Canyon?

Q Bear Canyon. I'm sorry. Bear Canyon. Is there a water table around the Bear Canyon Mine?

A Well, again, from a purely semantical issue, typically where a groundwater system is under pressure, that pressurized section is not referred to as a water table. Typically where it is not under pressure, or not confined, it is referred to as a water table. So in that area generally south of DH-1-A, the various tongues of the Star Point Sandstone were not under pressure; and so in that area, I would say yes, there is a water table beneath the mine.

Q Okay. But it's below where the mine --

A Below the mine.

Q Okay.

A Now, the system that's in the channel, I don't have enough data to be able to say whether that's under pressure or it's not under pressure, so I don't know if that channel system is --

Q And do you know whether the channel system is interconnected with the water table?

A I would say that -- with a reasonable degree of scientific certainty that it is not, if you are discussing the water table -- the water tables that are in the tongues of the Star Point Sandstone beneath the mine.

Q Okay. And what do you base that on?

A Again, the fact that the -- as we drilled the holes -- well, number one, the flow coming into the mine from the channel's coming from the roof or directly from the channel face itself. Once that face was encountered, water is not coming from the floor.

There -- I -- I do not recall there being any water that was encountered in DH-4, which was drilled fairly close to the -- it was drilled in that wet zone, so it was just south of the sandstone channel. I do not recall there being water encountered in the Blackhawk Formation at that point until we got down into the Spring Canyon tongue.

The presence of a fair amount of Blackhawk Formation beneath the Blind Canyon Seam, with its attendant low permeabilities, the fact that within the Spring Canyon tongue we do see pressure as we move to the north, as we get closer to that channel sandstone, we're seeing upward pressure above the top of -- above the top of the mine.

And with an upward pressure at that location in the Spring Canyon tongue, that indicates to me that there's very limited likelihood that the sandstone channel would be hydraulically connected to that -- to that Spring Canyon tongue; so if it's not connected to the Spring Canyon tongue, it's not going to be connected to the Storrs or the Panther tongue.

Q Do you have any explanation other than coincidence of why the water in Birch Spring and the water in the channel is approximately the same age?

A No, I don't. I do know as I look through the Mayo data and looked at the age of the water just to the west of the Blind Canyon Fault that would be essentially -- essentially in line with the channel -- it was just south of where the channel was encountered that they took the sample, significantly further north of Birch Spring -- looking at the age of that water, it's roughly 5,000 years, as I recall, for the Spring Canyon. For the channel sand to have to flow across that dry fault and through that water that's 5,000 years ago and get down into and come out at the same relative age is just -- it doesn't make sense to me it would take that route to get there.

Q Okay. Did you work with Co-Op during the time when they were pumping water into their worked-out parts of the mine?

A We were involved, I believe -- that was about the time frame that we got involved with them. And I -- I believe that our first involvement on the -- on the groundwater issues with the mine occurred after they had already been pumping.

Q Are you familiar with which parts of the mine they were pumping water into?

A As -- I'm going -- I don't want to sidestep your question, but I'd have to look at a map to refresh my memory. I didn't look at that before I came in.

Q Let's look at a map. Let's take a minute and look at a map here. I think we've got a couple of maps that show the inside workings of the mine. Why don't you look at Exhibit 1. That's probably a good map. Do you know what areas they were pumping water into?

A I don't. If -- you apparently do, so if you'd like to point it out, we can --

Q Well --

A -- we can cut to the chase.

Q -- Mr. Reynolds probably knows that, if you don't. Go ahead --

A I'd really prefer --

Q Mr. Reynolds can show us where they were pumping water into the mine. I'm not trying to make things difficult.

A I recognize -- and I don't want to answer the wrong question, so --

MR. REYNOLDS: (Indicating)

Q (BY MR. SMITH) He's pointed to this here -- right here (Indicating).

Now, when they were pumping water in that part of the mine, that's when they had those real high flows on your chart --

A Yes, on Birch --

Q -- on Birch Spring.

A Yes.

Q Do you think those two events are connected?

A I -- I don't know. As I've -- I think that there is -- it's my opinion that there's a very low likelihood that they are connected.

Q Any other explanation you have for that, the anomalous -- and also at the same time, the reduction in water quality in Birch Spring. We're talking about this period right here (Indicating) this spike.

A Right. The one time -- I had not been out to Birch Spring, when samples had been collected, to observe the sampling. I know Mr. Garr was out at Birch Spring when samples were collected at the spring. And his comment to me was that there was very poor quality control on the sampling and that he had -- this was an event that, as I recall, was in later time. It wasn't during this peak; it was at a later time. But his comment to me was that he was very concerned about the quality control, and that did not leave him with a high level of confidence in the data, so --

Q Were you here when we had the people testify about the spike? Or maybe you weren't here for that part of the hearing.

A I've been in other hearings where I've heard them talk about it.

Q I guess my question is, Do you have an explanation for this spike?

A No, I don't.

Q Okay. I understand it, Mr. White, that you're the person who designed the testing that later became the PHC.

A Mr. Garr and I did jointly, yes.

Q Did you take input from Co-Op on that or did you come up with the testing yourself?

A As I recall, Co-Op basically asked us to address some concerns and left the program generally up to us. Of course, we interfaced with Co-Op because we were going to have to be in their active mining operations and wanted to make sure we were in areas that were not going to create safety problems. And so we interacted with them, but it was our recommendation as to where the holes go, and they approved them based on, again, making sure that we weren't going to be a hazard.

Q Was it your recommendation to do just three holes?

A Yes.

Q So it wasn't where you went to Co-Op and said, "We'd like to do six," and they said, "No, that's too expensive. Do three"?

A No.

Q Three was the most you wanted to do?

A Yes.

Q And you feel like that was enough to do what?

A To characterize the hydrogeologic system.

Q And you're the person who made that decision?

A Again, Mr. Garr and I discussed that jointly.

Q And you were Mr. Garr's boss during that period of time?

A We have a -- I don't want to get into an extended management discussion here.

Q Well, I just want to know where the final decision was.

A I don't order anybody, Mr. Nielsen.
Q My name's not Mr. Nielsen, but that's okay.
A Mr. whoever -- what's his name? -- Smith.
Q Thank you.
A I don't order anybody, Mr. Smith. We had a discussion and Mr. Garr and I came to a conclusion. I don't recall telling Mr. Garr that regardless of what his opinions are, we will drill three holes and we will drill them in these -- these locations.
Q I'm trying to -- I'm sorry.
A I do recall having a very congenial conversation discussing what we thought was appropriate to answer the concerns. From that came three drill holes. I was comfortable with that; so was Mr. Garr.
Q I'm trying to understand who had the final decision on these things. I don't care how your management style is.
A You can say I did, if that would help. We don't make decisions that way. We came to a joint conclusion. And I don't recall having Mr. Garr stamp his feet and say, "Absolutely this way." I don't recall doing that myself. I think we jointly came to that conclusion.
Q Okay. Have you performed any other analysis since the PHC --

A Yes.

Q -- at the Co-Op Mine?

What have you done since the PHC?

A Of course, in preparation for this hearing we've updated the data. There was additional data that we were provided by the water users association. We've updated our database on the water quality information, the water level information that Co-Op collects. It's been three or four years since the PHC was prepared, so we had to update our database and reevaluate information as the data were collected to make sure that we weren't seeing anomalies that we couldn't explain. And, of course, as we've had our discussion here, there have been some numbers that I've presented that were numbers that got generated within the last week or so.

Q Okay. How about chemical analysis? Have you done any additional chemical analysis work?

A I personally have not. EarthFax has not collected any samples. Co-Op has a monitoring program where they periodically collect samples from various streams, springs, wells, and we have obtained copies of the data from them.

Q I see. Other than the tritium analysis that's been testified to today, any other tritium analysis we haven't heard about?

A To the best of my knowledge, it's Dr. Mayo, Mr. Nielsen. And then we collected the data back in 1992, '93. But that's the only data that I'm aware of.

Q I understand since the PHC was done, there's been an up-gradient well drilled by Co-Op.

A There have been the surface drill holes that are shown on a cross section of Exhibit C-7: SDH-1 and SDH-2. I don't recall off the top of my head what the date was. Charles could tell you that. But those were done since the -- since the PHC was originally written.

Q Has information been taken from those that have gone into any of your testimony today?

A We discussed the potentiometric surface in the Spring Canyon tongue as you go north. We discussed the information that was collected out of those holes.

Q And has that data been given to DOGM, or do you know where that is?

A I don't. I'm not sure. Those holes were drilled separately by Co-Op, and so I don't know what the status of submittal on those holes is.

Q I want to ask you some questions about the PHC just to see if these are still your testimony. I'd be happy to share my copy, but I wouldn't be able to give you the question.

A That's the whole point.

Q Then you'd have to go home.
This is on page 2-6, if you have that.
A I think we've got a copy. Let me --
(A discussion was held off the record.)
THE WITNESS: Before we take the break, just to make sure that we're reading off the same document: Up in the upper right-hand corner, does yours say, "April 30th, 1993"? Look at one of the text pages. Look at page 2-6, for instance.
Q (BY MR. SMITH) Yeah, mine does.
A And down in the bottom in small type does it say, "Revised 1-31-95"?
Q Mine does not.
A So I have, I guess, an older copy. So if there are some differences, we'll note that.
Q On page 2-6 it says, "The Castlegate and the Start Point Sandstones are regionally continuous. Although the Castlegate Sandstone contains some water, it is not considered to be a regional aquifer." Do you agree with that statement?
A Yes.
Q "The Star Point Sandstone, together with the lower Blackhawk Formation (Blackhawk-Star Point Aquifer) are considered by Lines to be a regional aquifer." I guess you've already --

A I already agreed that Lines considers them to be a regional aquifer.

Q Down at the bottom of page 2-8, it says, "Danielson, et al., indicate that recharge to the Star Point-Blackhawk aquifer from direct infiltration of snowmelt to formations which outcrop below the North Horn Formation is small in comparison to recharge through low relief surfaces on the North Horn Formation." Do you agree with that statement?

A Yes.

Q "In the study area, exposures of formations below the formation and above the coal outcrops are limited to steep canyons." Do you agree with that?

A Yes.

Q "Therefore, the potential for recharge through these formations to the regional groundwater system within the permit area is limited." Do you agree with that?

A Yes.

Q Down in the middle of the page, it's the second-to-the-last sentence. It says, "The two largest springs in the area (Big Bear Springs and Birch Springs)" --

A Right.

Q Do you find that?

A Okay. Got you.

Q "The two largest springs in the area (Big Bear Springs and Birch Springs) are associated with fault and joint zones and issue from the Panther Tongue of the Star Point Sandstone." You agree with that, I take it?

A Yes.

Q Okay. Skipping ahead, go to page 2-13, last paragraph on 2-13: "Prior to 1991, mine water inflow was small and often insufficient to meet the operational needs of the mine." I'll skip the citation. "During 1991, mining proceeded into the northern portion of the permit area and groundwater inflow to the mine increased." I take it that's a true statement?

A Yes.

Q "During 1991, Co-Op Coal Company began discharging between 30 and 60 gallons per minute from the mine. By January 1992, mine discharge increased to 300 gallons per minute and continued at this rate through March of 1992. Present total mine inflow is approximately 500 gallons per minute. Of this total, 200 gallons per minute is used in the mining operations, and 300 gallons a minute is discharged in Bear Canyon Creek." Is that --

A No, that's -- that's a revised -- that apparently was revised.

Q Okay. Why don't you tell me what the revised statement is?

A The last two sentences there at the top of page 2-14 said, "Present total mine inflow is approximately 210 gallons a minute. Of this total, 30 gallons per minute is used in the mining operations and 180 gallons per minute is discharged to Bear Canyon Creek."

Q Okay. So you're reading that -- that corrects the -- and you agree with that statement you've just read?

A Well, certainly as of January of '95. It's been two years since, so those flows may be somewhat different, but it was correct at the time.

Q Okay. Down at the bottom of page 2-14, it says, ". . . the age of water from Big Bear Spring cannot be determined." I take it that opinion would be revised with Dr. Mayo's work?

A Yes. As I indicated, I would definitely defer to Dr. Mayo for an interpretation of the radioisotope data.

Q And it says, ". . . (the) Birch Spring water and the mine inflow are of similar age (pre-1953), and are not significantly recharged by modern precipitation." Do you agree with that statement?

A Yes, within the -- within the restrictions on my understanding of radioisotope.

Q Okay. Go to page 2-31.

A That's a figure in my -- what's the --

Q We're in the section -- it is 2.2.2, "Groundwater Quantity Impact." 2.2.2, "Groundwater Quantity Impact." And on mine it's page 2-31, but I guess with the revised version it might have been changed.

A Oh, got you.

Q Okay. Where it says, "Drainage of water from faults and fractures produces the largest volume of water flowing into the mine." Is that a correct statement or not?

A I would say no, now that -- definitely now, the largest volume of water flowing into the mine is from the sandstone channel.

Q That would have been true then; you just didn't know about the sandstone channel at that time?

A Yes.

Q Okay. Are you familiar with the CHIA at all? Just have a couple of questions on that.

A Generally. I don't recall that I have ever fully read the CHIA, so . . .

Q Let me just ask the questions. I have a couple of questions from the CHIA. I know you didn't prepare that. I'll just read -- this talks about the Bear Canyon Seam, current mining. Just for the record, I'll indicate this is on page 4 of the CHIA dated March of 1994 -- I'm sorry -- August of 1989, revised on March 1994. I believe this is the latest CHIA that's in the file, so we've got it just out of the Division's files a little while ago.

On page 4, under "Current Mining in the Bear Canyon Seam," it states, "Areas of encountered groundwater within the mine are fractures which drain over a period of several months as the mine advances northward. This indicates a high degree of hydraulic interconnection through fractures in the portion of the Blackhawk Formation which overlies the mine." Do you agree with that statement?

A For a -- for a limited aerial extent and a limited vertical extent, I think that's probably a reasonable -- the only place we really saw significant inflow, again, was as the mining progressed near that channel sandstone. And so in that area, either where roof bolts encountered the sandstone or where there were fractures in the roof, there was a reasonable amount of inflow. And those fractures expanded vertically somewhere, but I would not agree that it would be appropriate to draw the conclusion that those fractures extend all the way to the surface.

Q Okay. One more question and maybe we can take a break. One more question on this. I have some more questions, but not on this document.

On page 7 of the CHIA, at the bottom of that page it states, "Mine inflow of approximately 300 gallons per minute is discharged to Bear Creek at the Bear Canyon Mine and the remainder is used in the mining operations. No discharge occurs at the Trail Canyon Mine. Mine water within the CIA represents groundwater depletion from storage in the Blackhawk Formation and the Star Point Sandstone and the interception of flow along faults/ fractures." Do you agree with that statement?

A I would agree that it represents interception of storage in the Blackhawk. I would not agree that it represents interception of storage from the Star Point.

Q So you disagree with that?

A Yes. Well, I agree with a part and disagree with a part.

MR. SMITH: Okay. Maybe this is a good time. We can take our five o'clock break.

MR. CARTER: Let me also ask what all we hope to accomplish before we break for the day and what else -- Craig, you indicated you've got --

Let's go off the record.

(A short recess was taken.)

MR. SMITH: I'll just get wrapped up. I have a few more questions of Mr. White.

Q (BY MR. SMITH) And I just want to get your views on some of these publications that -- I'm sure you've seen the same ones. I don't have very many. I just have a couple. The one I'm reading from is "Hydrology of Area 56." Have you seen that before?

A I have.

Q It's published by the USGS, Open File Report 8338. And there on page 16, I'll just read the statement that says --

MR. HANSEN: Just for the record, can we get a publication date?

MR. SMITH: Oh, yeah, that'd be fine. It was published in 1984.

Q (BY MR. SMITH) And these are generally available. I'd give you a copy for you to look at but I only have one of these to read.

A Again, that's the purpose.

Q "Dewatering of coal mines changes the flow pattern through coal-bearing aquifers, and storage in the aquifers is reduced." Do you agree with that statement?

A Yes, generally.

Q I know these are general statements and a lot of these are in different areas. I want to try to focus on the Bear Canyon Mine, so tell me whether you agree with that. Do you agree with that in connection with the Bear Canyon Mine?

A Certainly. As I indicated earlier, when -- as water is removed from the mine, they are removing water from storage from the Blackhawk Formation, so yes.

Q This report -- and this is one by Mr. Lines, who is well known in these sorts of reports --

A Which one is that, by the way?

Q This is the "Hydrology of Area 56" by Gregory Lines.

A That's the one we were just going through.

Q Yeah. And he says, "(The) groundwater storage has been reduced around all water-producing mines in the area." Would you agree with that statement as to the Bear Canyon Mine?

A Yes. Storage, yes. And, again, maybe if there's -- somebody's having a hard time with it, the storage is basically -- it's as though you have this bathtub. And so if you take something out of the bathtub, you've reduced the storage. So any time water is discharged from the mine, something has been removed from storage.

Q Okay.

A Assuming, again, it's under water table conditions and -- assuming that it is under unconfined conditions, yes. It is not under confined conditions. Technically speaking, if it's under confined conditions, it's not released from storage; it's released from pressure.

Q Thanks for that clarification.

Page 18, Mr. Lines states, "Land subsidence and associated rock fracturing above underground mines can cause changes in the natural pattern of groundwater flow, can change the flow of springs, and locally can alter surface runoff." Any evidence of that occurring around the Bear Canyon Mine?

A Read that again.

Q "Land subsidence and associated rock fracturing above underground mines can cause changes in the natural pattern of groundwater flow, can change the flow of springs, and locally can alter surface runoff." Is that a concern around the Bear Canyon Mine?

A I'm not aware of subsidence effects that have impacted groundwater, nor am I aware of subsidence that has, on any significant scale, impacted surface water. I believe there have been a couple of subsidence cracks that developed that either naturally filled in or that Co-Op filled in. So at least on a short-term basis, yeah, I think there were some surface water impacts from subsidence -- for short-term. I'm not aware of any groundwater impacts that there have been.

Q All right. Thank you.

The next publication is the "Hydrology of Alkali Creek and Castle Valley Ridge Coal-Lease Tracts, Central Utah, and Potential Effects of Coal Mining." Are you familiar with that publication?

A Yes, I am.

Q And obviously we're going to talk about just a couple of quotations on the Castle Valley Ridge, not the Alkali Creek, which is somewhat removed.

A Yes.

Q For the record, which is Water Resources Investigations Report 87-4186 -- and it has a publication date of 1988 -- and going to page 1 of that. And the authors are R.L. Seiler and R.L. Baskin. On page 1 it states, "Groundwater in the Castle Valley Ridge area occurs in perched aquifers." You would agree with that statement?

A Yes. I'm not exactly sure what -- what their boundaries are for the Castle Valley Ridge, but as I recall, it's in that general vicinity.

Q Yeah, it's fairly close to the Bear Canyon Mine?

A Yeah, that's -- I would agree with that.

Q "The Blackhawk Formation and Star Point

Sandstone form a regional aquifer in the southern Wasatch Plateau coal field; however, this aquifer is a localized aquifer in the Castle Valley Ridge area." Now, I know we've done a lot on regional aquifers. Anything you could say about that statement, whether it's to clarify your position on that?

A I would have to follow the "however" with probably another "however," that within the Bear Canyon permit -- Bear Canyon permit mine area, that as we've discussed, there are three distinct groundwater systems beneath the coal. How regionally extensive those are outside of the permit area, I don't know. Undoubtedly, somewhere they fit into what -- into that report's first "however." Out there, they'd probably fit into that "non-however" statement.

Q Okay. Thank you.

Going to page 42 of the same publication, it states, "Subsidence above the proposed mines on the Alkali Creek and Castle Valley Ridge coal-lease tracts probably will have the greatest effect on the hydrology of the areas studied. Fractures caused by subsidence could divert surface- and ground-water flow to lower strata or to the mine workings. Subsidence caused by mining could cause spring discharge to decrease or cease and disrupt the major source of water to livestock and wildlife in both areas." Has that been a concern for the Bear Canyon Mine?

A Again, I'm not aware that those impacts have occurred. That those are always possibilities, as the report indicated, those are things that could happen. And -- but I'm not aware that that has occurred within the Bear Canyon area.

Q And so I take it that's not been addressed as a probable hydrologic consequence?

A I believe we did address impacts in the Probable Hydrologic Consequences. I just don't believe we -- and I'd have to read it to be sure, but we may have even made a statement that that could occur, because, again, all things are possible. But I don't recall that that impact has occurred.

Q Okay. And I take it however it's addressed, you have no different view of the subsidence and how it's addressed in the PHC? You take that to be correct as to how subsidence is addressed?

A Yeah. And again, I'm not exactly sure, without going back and reviewing it, what the -- what the wording was that we used in the -- in the PHC. We could look through there and figure that out. But we did address the fact that subsidence was a potential impact pathway.

Q Okay. Going next to the "Hydrology of the Coal-Resource Areas in the Upper Drainage of Huntington and Cottonwood Creeks, Central Utah," are you familiar with that publication?

A Yes.

Q And that's another one by the USGS. It's dated 1981. The authors are Terence Danielson, Michael ReMillard, and Richard H. Fuller. Going to page 1, it states, "The Star Point Sandstone and the lower coal-bearing part of the Blackhawk Formation, both of Cretaceous age, are saturated in some areas, and the aquifer yields water to underground coal mines." Is that true in the area of Bear Canyon Mine?

A The portion that says that the Blackhawk yields water to the coal mine, yes. That's where the water is coming out of that channel sandstone is out of the Blackhawk Formation.

Q How about where it says the Blackhawk's saturated? Would that be true in the Bear Canyon --

A Well, it is certainly at the Star Point Sandstone. Generally, no, I would not say that the Blackhawk is saturated.

Q "Most of the larger discharging springs in the study area issue from the Star Point-Blackhawk aquifer where faulted." Is that true around the Bear Canyon Mine?

A What was that again?

Q "Most of the larger discharging springs in the study area issue from the Star Point-Blackhawk aquifer where faulted."

A Again, you'd have to take the Star Point out of the equation at the Bear Canyon Mine. Definitely we've seen near the channel sandstone where fractures in the roof, as well as roof bolts, have been a source of inflow to the mine. I don't know as though I would classify those as faults. But again, the -- from looking at Bear Canyon Fault, essentially no water -- in fact, there is no water coming into the mine at the Bear Canyon Fault. And they haven't encountered the -- or, I mean, at the Blind Canyon Fault -- they haven't encountered the Bear Canyon Fault. Some minor fracturing does contribute, but I would not call it faulting.

Q Okay. The next sentence states, "Groundwater also occurs in several water-bearing zones above the Star Point-Blackhawk aquifer."

A Yes. I'm assuming that what he's referring there to is these perched zones that occur within the Blackhawk Formation as well as up in the Castlegate and the Price River and the North Horn Formation.

Q Do you know if that's true in the area that's been mined by the Co-Op in the Bear Canyon Mine?

A Certainly there are, as I recall, some springs up in the North Horn, up in the upper formations, that are going to be in discontinuous systems. We -- we -- up in the area to the north of the permit area. We normally make the assumption that within the Blackhawk Formation itself that there are discontinuous perched aquifers, so it's reasonable to assume that they exist.

Q Okay. Still on page 1, "Dewatering of underground coal mines was the largest manmade discharge from the Star Point-Blackhawk aquifer in the study area during 1979. The dewatering of mines has decreased the amount of water in storage in the aquifer, but water-level data were not available to define the extent of the depletion." Would you agree with that statement?

A Of course that's making a historical statement, and I'd have to agree that he's probably historically correct. Within the Bear Canyon area, yes, water that's discharged from the mine is encountered within the Blackhawk formation at the channel sandstone. And discharging water from that sandstone does deplete the storage that's in that sandstone.

Q Okay. "Other possible impacts due to mine dewatering include the diminution of spring flows and increases in groundwater recharge, both of which are more likely to occur where rocks have been fractured due to subsidence above mines."

A That's quite possible. Again, we haven't seen that at the Bear Canyon Mine. That is a potential impact.

Q Okay. Going on to page 37 of the same report, it says, "Water discharged from underground mines produces the same changes in the groundwater system as do wells." Would you agree with that?

A Read that again.

Q "Water discharged from underground mines produces the same changes in the groundwater system as do wells."

A Okay. I think what he's saying is that when you remove water from the mine, you're removing water from storage. Just like when you pump water from a well, you're removing water from storage. Assuming that's what he means -- and maybe the sentences before or after might explain it -- but assuming that's what he means, then yes, it is correct.

Q I'm not trying to take things out of context.

A I understand.

Q He's referring to a 1957 report by a person named Theis.

A Theis.

Q Theis. That's what he's referring to. You may have read that report.

A Yeah. That particular paper, if it's the one I'm thinking of, does talk about the fact that when you pump a well, you're removing water from storage. So that's -- that's what he's probably referring to. And he's correct. Any water that comes out is going to -- under unconfined conditions is going to be removed from storage.

Q Okay. Then he goes on to say, "Groundwater in storage in the Star Point-Blackhawk aquifer has decreased around all water-producing mines in the study area as indicated by the diminution of groundwater flow into the older working of active mines." Would you agree with that for this mine?

A I would agree that it does whatever the first part of the sentence said. I was in agreement. I think it was again talking about removal from storage, wasn't it?

Q Right.

A Yes, that would be the case.

Q It says then -- this is the kind of the last statement of the conclusions of this report -- it says, "To fully assess the hydrologic impacts of underground mining, comprehensive studies of the groundwater systems are needed in conjunction with monitoring of the quantity and quality of both surface and mine-discharged waters." Would you agree with that?

A Yes.

Q "Monitoring the discharge of individual springs to develop discharge-recession curves, in conjunction with water-level monitoring in properly constructed observation wells, is needed to detect possible unnatural changes in the groundwater system and to quantify unnatural changes in spring discharges." Would you agree with that?

A Yes, that would be appropriate.

Q And have you done those things with your PHC?

A Yes.

Q Okay. That's all out of the books. Just a couple of questions out of -- this is "Revised Hydrologic Evaluation of the Bear Canyon Permit and Proposed Expansion Areas." And I'm not sure if that -- that was done along with the PHC, I believe.

A Yeah, they were concurrent timewise.

Q How does this relate to the PHC, this revised hydrologic evaluation?

A They were -- the hydrogeologic evaluation was prepared as a -- as a -- basically a report of findings from the work that we did underground, the installation of the drill holes, and the data that were collected. It -- it -- it went, in a technical sense, beyond what's required for a Probable Hydrologic Consequences, but also did not get into the specific issues that the regulations require be addressed in Probable Hydrologic Consequences.

It was kind of a technical report to make sure that all the data that we had collected got summarized and got into a report. And then we used the information presented there as a basis for the development of the PHC. As I recall, both the hydrogeologic evaluation and the PHC went in as appendices to the permit application, so they were kind of supporting one another.

Q Okay. I had a couple of others, but we've covered those, so I'm not going to reask the same question. And this one I think we covered too, but just to be cautious, I'll ask it and move on to page 2-14. Talks about movement of water. It says -- I'll give you a second to get up to that -- "The movement of groundwater in the study area is strongly controlled by faults and the dip of strata. Most of the water movement in the study area is through fractures, faults, and partings between the beds." Do you agree with that statement?

A Yeah. Again, they were, of course, citing Danielson in that lime-colored report that you -- that you produced. And with the additional information that we've collected since, I would have to say that the influence of faults is probably relatively minor within the permit area. I think the fractures and the bedding planes, as well as the mere presence of less permeable layers around the more permeable layers, are probably the things that predominantly control groundwater flow.

Q So your position has been modified somewhat?

A Yeah. Not significantly, but somewhat. And I may be making a distinction among geologists that I don't need to, but my understanding of a fault is that it's basically a fracture that has offset. So they are similar in one sense but we don't see with -- we do see some fractures that things are coming from, but whether they're faults or not, we know that in the major faults the Blind Canyon Fault there's no flow along that. So I may be making -- making us a semantics problem here.

Q Okay. Going now to the chart that was prepared on Birch Spring on the flows, and you talked about the USGS measurements that had been done back in the '70s --

A Right.

Q -- there's more than one spring around Birch Spring. Do you know what was measured by the USGS for that flow?

A It's -- it came out of that lime green report of Danielson's.

Q Maybe you can direct me to the page, then.

A Yes. It begins on -- let's see -- the bottom of page 71 --

Q Okay.

A Spring 26 BCA-S1 is Birch Spring. And that -- there are a few measurements on the bottom of page 71 and some additional ones on the top of page 72.

Q Can you tell from that whether they measured all the springs that were there or just one of the springs that were there, or what was measured?

A From -- from my understanding, what they were measuring was the flow out of the collection system at the time, so whatever's included in the collection system in 1978 and 1979.

Q Okay. Do you know which parts were in the collection system that the time?

A I do not know what -- what, if any, changes have been made in the collection system that would have affected the area of flow between '78 and now.

MR. SMITH: Okay. That's all the questions I have.

MR. CARTER: Okay. Are we --

MR. APPEL: Mr. Reynolds.

MR. CARTER: All right. Let's move to that.

CHARLES REYNOLDS,

called as a witness for and on behalf of the Co-Op Mining

Company, was further examined and testified as follows:

FURTHER EXAMINATION

BY MR. APPEL:

Q Tell me as briefly as you can, realizing we're running short of time, how you set up your lines to your meters to catch the water from the mine. Where do you set them up? How do you collect?

A There are simply pipelines that are installed to the sumps. We have pumps in the sumps where the water's collected here (Indicating), at various locations. And they all come in through actually two separate pipelines that we've got installed in the mine. One is a supply line. One is a discharge line. They either go into one or the other. We do have a third line, which is our culinary water line. And the supply line has a meter on it. Culinary line has a meter on it. And then the discharge line, where it comes out and prior to discharging into Bear Creek, that's also got a flow meter to --

Q So you metered all three of the lines?

A Yes.

Q Where are those meters located? One is outside the portal, I guess?

A Yeah. The discharge meter is outside. The supply meter is just inside the portal, located up in this area of the mine (Indicating). The culinary water meter is located on the pipeline (Indicating).

Q Okay. So the lines follow that one main and then take a right angle or --

A Yeah, they come out and then come down here and out of the mine (Indicating).

Q There was some mention that you had drilled the sandstone channel to find out how thick it was?

A Yes. We -- we did some horizontal drilling through the channel to try to determine whether there was coal still ahead of us or coal on the other side of the channel anywhere close to us.

We -- the furthest we were able to drill out was, we drilled about 450 feet, which was the extent of what we could reach. We put several holes, which, in fact, are the holes that the isotopic data out of the 3rd West Bleeder were taken from. Those were the holes that were drilled through the channel. We would drill some horizontal holes at various angles to intercept the coal underneath and ahead of the channel.

We did find at about 425 feet ahead of it that the coal seam thickness began to increase. That was all the information we found. The coal underneath the channel got down to as low as six inches. The highest that it come up to when it reached the extent we were able to drill was near three feet.

Q Do you know how far above you, how far above the height of your coal shaft -- it's not a shaft; it's your main -- the sandstone exists? Did you drill up and find out where --

A No, we don't. We were primarily drilling for coal, to look at the coal. We did not drill up through there, the sandstone channel.

Q Did you encounter only sandstone in any of your holes?

A Sandstone.

Q Okay. Is there any hole that you didn't encounter coal in?

A That we were drilling horizontally there, no.

Q Okay. So you drilled until you hit coal?

A Yes. We would drill at a given angle until we penetrated the coal seam. They would -- then we would come back and drill at another angle. By surveying the holes and determining where we penetrated, we tried to draw a picture of what the coal looked like ahead of us.

Q Can you show us on the map where you did this drilling and then locate it so that if we -- by some coordinates that are nearby so when we look at the map, we can tell where you're talking about?

A It was in the 3rd West Bleeder. Like I mentioned, it was -- the drill holes we drilled were the holes that the isotopic samples were taken from in the 3rd West Bleeder. They were drilled here (Indicating) in a generally northward direction at various lengths going anywhere from 30 feet to 400 feet.

Q Okay. And that's the only place you did that drilling?

A Yes. We -- we did -- the water was -- sampled at this 3rd West South was also sampled out of a drill hole that penetrated the Blind Canyon Fault to the west. We did do some drilling on various angles, anywhere from 30 to 70 degree angles. Part of the purpose of that was to -- we were trying to look at the possibility of any Tank Seam coal that may be on the other side of the fault. It was the primary purpose of that drilling.

Q Did you do any strictly horizontal drilling?

A Through the fault? No.

Q No -- I know you're thinking about the fault -- through the sandstone mass.

A Through the sandstone channel? Not strictly horizontal. As you're drilling horizontal, usually the weight of your steel -- the further out you get, the more your drill steel will begin to bend. So technically, none of the holes are exactly horizontal. They're going to be a curve as you're drilling. By drilling at various angles, you get various curve out in front of it. But the drilling was primarily horizontal. We were drilling from the coal seam to the coal straight ahead of us.

Q Are you planning on mining beyond the sandstone channel?

A It's not very profitable mining six inches of coal. At this point we're not permitted to and we don't plan on mining beyond it.

Q Did you take any cores or do any drilling that indicates that there's an overlaying sandstone in the section?

A We did not.

Q So you don't know if there's -- you heard the testimony before that there's some sandstone overlaying your coal seam?

A Yeah. We don't know how far out that comes other than looking at where we encountered the water coming in from the roof drips here (Indicating).

Q So you have not done any corings to determine if it's actually coming from sandstone?

A Well, the roof bolting -- we have had several roof falls in that area of the mine that have penetrated up to -- we know there is sandstone above us.

Q Do you know how thick it is?

A We never -- we haven't tested in this area to see just how thick it is.

Q Do you have anything to indicate there's sandstone farther forward, in your mind, away from the current working face?

MR. CARTER: South, you mean?

MR. APPEL: South. Thanks.

MR. CARTER: I saw which way your hand moved.

MR. APPEL: It was a twitch at this point.

THE WITNESS: There are -- there are some -- there are some sandstones throughout the area immediately above the coal seam. Whether they're continuous, I don't know. I do know at the Blind Canyon portals there's sandstone immediately above the coal at the outcrop there. We do know, in drilling from here into the Tank Seam, that there are several layers of sandstone throughout the Blackhawk Formation in between the seams, that they're also interbedded with many layers of shale.

Q (BY MR. APPEL) Can you show us -- stay at the map, if you would, for a moment -- where the face would be that you were mining in 1989?

A Let's see. Right here (Indicating) the map shows a date of November 28th, 1989.

Q That map references dates?

A Yes, this map shows dates of mining throughout the mine.

Q Okay. And in 1990, is work advancing?

A We advanced a portion of it. The date indicates that we were here (Indicating) at November 20th, 1990. There again, mining was not continuous because we certainly normally advance further than that in a year. But because of the quality of the coal, we were having to blend it with coal from other areas.

We had advanced -- let's see -- from where that water shows, approximately four pillars by November 20th of 1990. The next date on here is the date at the end, which shows April 27th of '93.

Q How about the other main?

A Over here (Indicating?

Q Uh-huh (Affirmative).

A We do show this section (Indicating) was started in November of '89. First date on here shows right here (Indicating) of April of '90 -- April 12th, 1990. Where we mined into the face here was March -- March 30th, 1992.

And I might mention -- and I'm not a geologist, but I would anticipate, due to the elevation and slope -- we did not encounter a -- significant amounts of water in this area of the channel that we did in this area of the channel (Indicating). We did get some roof dripping, which has dried up currently. The only water you see in that is water that's flowing out of that drill hole going into the channel.

Q When did the mine encounter the location where Drill Hole 1 is?

MR. HANSEN: Did the mining operation encounter water at DH-1?

THE WITNESS: We did not. The time that we mined through that -- we reached the end of that section in April 21st of 1986, so I assume it would have been in or of '86. It would have been in March -- February or March of '86.

Q (BY MR. APPEL) You drilled two surface wells, "you" meaning Co-Op?

A 1994 -- let's see. Actually, I think it was in the fall of '93, we actually put three surface wells that we drilled north of the permit area on federal leases that we'd have. This was for the purpose of evaluating and -- both geology and hydrology for the purpose of generating potential permit application for that area. That permit application has not been generated. It's still under evaluation. And that is not part of our permit area.

Q Do you have drill logs from that?

A We do.

Q Okay. Who did the drilling for you?

A Bob Beeman Drilling drilled the holes for us. They were supervised by Greg Hunt.

Q Were you looking for water?

A We were looking for water and coal, qual and quantity.

Q Where did you find water?

A Primarily we didn't encounter much water there. We did, as we were going down, intercept various perched aquifers, perched areas where there was water in the hole.

The primary purpose of the monitor wells that were installed was to monitor the Spring Canyon Sandstone, because that's the underlying aquifer of the coal seams. And so we -- they pretty much drilled right to the bottom. And we had already -- prior to drilling had designed to install the wells in the Spring Canyon -- in the Spring Canyon member of the Star Point Sandstone.

Q Do you have any current monitoring devices down in that member?

A Well, it's -- currently it's not part of our permit area and it's not part of our -- our required monitoring program. We do have well-level equipment installed in two of the wells. This well, we have -- we did get some data out of it the first year. We have since encountered a plug in there, in that well, which --

we're looking at the -- the options we have of being able to go back in and open it up.

Q Was there any formation you drilled in which you didn't encounter water?

A Oh, I'm sure there was.

Q You don't know what it was?

A We -- let's see. They were drilling with air through -- let's see -- SDH-3. Most of the hole was actually drilled with air, which means there was very little water encountered.

MR. HANSEN: If you don't remember, say you don't remember.

THE WITNESS: I don't remember. I would have to review the log.

Q (BY MR. APPEL) But Co-Op has those records in its possession?

A We do.

Q Were there formal reports prepared?

A There -- they will be prepared. When we look at permitting area.

Q Do you have an assemblage of information?

A No. Currently the drilling information is a confidential document.

Q Why?

MR. CARTER: Just proprietary information they generated for the purposes of getting together an application, I would guess. I mean, when they file it with the Division, it will become public.

Is that about right?

THE WITNESS: Yeah.

MR. CARTER: It's not something we ask them to do.

MR. APPEL: I understand. We'd like to review the information for the purposes of water. We're not in a competitive coal exploration venture.

Do you have any objection to that, Mark?

MR. HANSEN: I don't know exactly what the data is. I think we'd have to look at it and make that determination. We've stated that the holes were drilled for exploratory purpose and it is confidential and proprietary.

MR. APPEL: Well, he said two purposes. He said hydrogeology too.

MR. SMITH: That's right, and they've been made an issue in this proceeding. I believe you've had testimony that people have relied on information gathered there.

THE WITNESS: Currently -- maybe I'll add for clarification -- currently we have one single initial well measurement out of it. That is the data that

EarthFax has used to plot this. So that is the information that we have generated from it.

MR. APPEL: Okay.

MR. HANSEN: Just for the record: I'm not meaning to be difficult. I just haven't spoken with my client. Personally, I don't care one way or the other. But Charles says that Co-Op considers the information proprietary. I don't have authority to waive that privilege without speaking to them first.

MR. APPEL: And I'm simply asking that you speak to them and get back to us. Since your experts relied on some of their -- it's important.

THE WITNESS: Co-Op's position is, currently that really doesn't have any bearing on our existing permit, on our existing PHC.

MR. CARTER: I understood --

MR. HANSEN: I think the question is going to be, Does Co-Op Mine have a problem producing the hydrologic information it acquired from those two holes? Is that correct?

MR. APPEL: (Moves head up and down.)

THE WITNESS: I would have to consult -- we don't have a problem with the information that has been produced that's shown on this diagram.

MR. APPEL: We are interested in where you've encountered other water.

MR. HANSEN: You're asking for the data underlying that chart, basically. Isn't that it?

MR. APPEL: Well, we're asking probably for the drill logs and any information derived from that that pertains to water.

MR. HANSEN: What are the drill numbers, hole numbers?

THE WITNESS: SDH-1, SDH-2, and SDH-3. We were not specifically looking for water in the upper formations. As I mentioned earlier, the purpose of the wells were to look at the underlying aquifer in the Star Point Sandstone.

Q (BY MR. APPEL) So one of the purposes -- I'll leave it alone.

MR. CARTER: They'll check and see if they're comfortable.

MR. APPEL: I have nothing further.

MR. CARTER: You can decide if it's a problem.

MR. HANSEN: Again, for the record: I have no problem. I haven't been authorized to release the data. I think I know exactly what data you request. I will bring it up with them and I will even encourage them to provide it.

MR. APPEL: And then let us know.

MR. HANSEN: And then let you know.

MR. SMITH: I have a couple of questions of Mr. Reynolds.

MR. CARTER: I was about to say as we approach 6:00, "If you had ten minutes, what would you do with it?" Keep that in mind as you ask your questions because I'm getting in deep trouble if I'm not back in Salt Lake by 8:30 or 8:45.

MR. SMITH: I have a couple of questions Mr. Reynolds.

FURTHER EXAMINATION

BY MR. SMITH:

Q As I understand it, the monitoring of water inside the mine was -- you measured by meter the water that was used inside the mine, correct?

A (Witness moves head up and down.)

Q You need to say yes or no for the record.

A Yes. By "metering the water": discharged from the mine as well as the amount of water used in the mine.

Q That's right. And is that the same discharge records that were turned in as part of your discharge permit?

A Yes.

Q If someone were to testify that there was three to four times that water actually discharged because you're over your permit and didn't want to disclose that to the governmental authorities, would you say that's a true or a false statement?

A That is false. There is no limit to the amount of water that can be discharged in a permit. There never has been.

Q Okay. When was it you were discharging water into the old workings, worked-out part of the mine? What years was that?

A It would have been the year of 1990 and the first part of 1991.

Q If someone were to testify it was the summer of 1989, that would be wrong?

A I would have to say yes. We didn't even encounter the water until -- till later, later -- later in '89.

Q Well, I know that's what your maps say, but I'm just saying, Are you sure that's true? I can draw a map that says you encountered water in the year 2010. But it's your testimony it was 1990, not 1989?

A That's correct.

Q And if someone were to testify it was 1989, they would be in error?

A I would have to say yes. My records show it was 1990.

Q How about your recollection? Do you have any recollection of that?

MR. HANSEN: He's already said he wasn't there at that time.

MR. SMITH: Just let me make my record, Mark; then we'll be done.

Q (BY MR. SMITH) What's your recollection of that, if any?

A Of discharging into the old workings?

Q Yes.

A When I first began working for them, they were -- or working for Co-Op, they were discharging into the old workings.

Q And when did you start working for Co-Op?

A In June of 1991. And it was in -- I don't remember the exact date of the hearing which occurred in 1991, but it was shortly after that hearing. I believe the hearing may have been May of 1991.

Q Now, how many --

A It was shortly after I began working that was discontinued.

Q How many discharge points did Co-Op have from the mine?

A From the mine?

Q Yeah.
A Just one.
Q So if someone were to testify that there was one by the fan and there was one that went to the ballpark, there was more than one, I guess your testimony would be that's inaccurate?
A That's correct. There's not a discharge that went by the fan. The water that goes to the ballpark is off of our culinary water system. That is not part of the discharge. That is addressed in our discharge permit. But the state does not require a discharge permit for culinary water.
Q I see. So your testimony would be there's only one, there's not three, like someone else might testify to?
A That's correct.
MR. CARTER: Just to make sure: Wasn't it generally agreed that there was a short period of time during which there was a discharge taking place at the fan, or was that not clearly established? I don't know.
THE WITNESS: That statement was made by Mr. Atwood. I am not aware of that ever occurring.
MR. HANSEN: That was not agreed to.
MR. CARTER: I see. Thank you.
MR. SMITH: That's all the questions I have.

MR. CARTER: All right.
MR. HANSEN: We're done.
MR. APPEL: Let me briefly call Mr. Leemaster.
MR. HANSEN: Oh, certainly.
MR. CARTER: Yeah, that's fine. Let's do that.

DARREL LEEMASTER,

called as a witness for and on behalf of the water users, was examined and testified as follows:

EXAMINATION

BY MR. APPEL:

Q Would you identify your name?
A Yes. My name's Darrel Leemaster.
Q And for whom do you work?
A I work for Castle Valley Special Services District, district manager.
Q Is one of your responsibilities water quality for Big Bear Springs?
A Yes.
Q Okay. And in the course of performing those duties, are you required to determine the source of that water?
A Not necessarily required to. We do have to do such things as source protection and make sure that we have areas that are protected. And if the Division of

Drinking Water were to require, we would have to show them if it was groundwater- or surface-influenced water.

Q Were you present during Dr. Mayo's testimony this morning?

A Yes.

Q Do you remember him saying that he believed there was recharge along the fractures from the creek?

A Yes.

Q Which creek would that be?

A I think that he was talking about Bear Canyon Creek. That's my understanding.

Q Do you agree with his conclusion?

A No, I don't.

Q You believe it to be completely erroneous?

A I do.

Q Why?

A Because we have run water quality samples on the spring where we identified the particulates that were in the water, specifically looking for anything that would relate it to surface water, and we didn't find any.

Q And you've also tested the creek?

A We haven't tested the creek because we know it is surface water and those particulates that we were looking for would be in there because it was surface water.

Q And you're not finding any particulates from that spring?

A We are not.

MR. CARTER: Let me ask a question. Wouldn't the movement of water through a quarter mile of sandstone have a tendency to change, if not the chemistry, at least the particulates, big bugs, and things like that? I'm asking based on my understanding that that's the technique that's being used to treat water in the sand filter and it's not a quarter mile of sand.

THE WITNESS: The technique that's being used is, as a large sample is collected, that sample is then examined for the kind of particulates that are in it. They're looking for such things as algae, pollen, amoeba, Giardia, Cryptosporidium -- any of those kinds of things.

Your question about the movement of water through sandstone -- I wouldn't be able to say how far it would have to move through sandstone before those things would be filtered out. But if it is close, as their testimony said, quarter of a mile away, you would expect that it would show up at this point.

MR. CARTER: Okay. I'm just asking that -- that's a lay sort of question, because I don't think I understood the testimony to be that -- well, I thought I understood the testimony to be that where the stream crosses the sandstone upstream from the spring is a possible recharge area. I think he said something like, "I think I sensed there's a connection, and that seems to me to be the kind of place that it would be possible." I'm not sure he specifically said it's definitely recharging. But I think I understand the concern.

THE WITNESS: I'm not sure he specifically said that either, but that's what he was implying, as well as formations cross the creek -- where the creek cross those, that that was the place where it'd be recharged.

MR. CARTER: So having tested and compared stream water with spring water, you see a difference?

THE WITNESS: Well, we didn't actually test the water in the creek. What we did was test the water in the spring. And in those tests we found no particulates that showed they ever had any surface contact.

MR. CARTER: Okay.

MR. HANSEN: Are you through with your direct?

MR. APPEL: Yes.

EXAMINATION

BY MR. HANSEN:

Q Mr. Leemaster, please tell us all your background in geology.

A I'm a civil engineer. Geology class in high school, geology class in college. I don't profess to be a geologist.

Q You don't profess to be a geologist?

A I don't.

Q Would you give us your background in hydrology, please.

MR. SMITH: I'm going to object. I think we're wasting time.

MR. HANSEN: We're not. He's professing to give an expert opinion --

MR. SMITH: He hasn't qualified as an expert. He's reported on results of tests they've given. I just think it's a waste of time.

MR. HANSEN: He's stated an opinion. I'm entitled to find out the basis of his opinion.

MR. APPEL: No, he stated that he had data that indicated something completely different from what Dr. Mayo said rather cavalierly.

MR. CARTER: Here's why I asked my question, because I think there's a difference between hydrology and water biology or water quality for the purposes of drinking water. And I understand the concern that you can't rely on a surface source without treatment, but I think there's a distinction.

What I was getting at is if the recharge area were ten miles away, then there'd be no problem with a concern that's -- you have surface influence, because the water is, we've heard dozens of times -- is all coming from the surface; it's not coming from down below. So at some point, it's all been surface water. The thing is, when it gets to the spring, it's suitable to drink.

And -- I mean, if his -- and so I guess where I'm headed is, I think Mr. Hansen's questioning is okay if the testimony is being offered to demonstrate a lack of hydrologic connection.

MR. APPEL: No. What we're asking him to do is testify what information he has gathered in the course of his employment as to water quality of that spring and whether he believes, based on reviewing that, that it's the same as the creek water. That's it.

MR. CARTER: Let me see if I can short-circuit this. Then he would be offering testimony for the purpose of showing that the water that emerges at the spring is not surface-influenced within the meaning of the Safe Drinking Water Act regulations and those kinds of things?

MR. APPEL: That's right.

MR. CARTER: That's what his tests led him to conclude to be the case?

THE WITNESS: Right.

MR. CARTER: Which I see as a different thing. It may be the same, but I don't see it exactly the same as hydrologic relationship.

MR. NIELSEN: Well, that depends if it's within a quarter mile or not.

MR. CARTER: True.

Well, let me -- in view of the late hour, let me close by asking -- what I will do is, we'll wait until we have a transcript, but I will ask that -- Mr. Hansen's going to check with his clients to see if providing the well logs on the two wells is okay. And if it is, that's fine. If it's not, you can decide what you'd like to say to me about that.

But I'll then likely -- depending on how long the transcript takes, I'll set a period of time for a simultaneous submittal of, basically, closing arguments. And in that letter to you, I'll ask several questions -- and I think I've hinted as to what those might be -- relating to the de minimis exceptions and those kinds of things. So that's basically how I plan to proceed. With any luck, the whole process wouldn't take longer than 45 or 60 days.

MR. APPEL: If we're looking at the 10 to 15, then it's likely that I can live within 30 days, so I'll let you know, though.

And we also need copies of your exhibits shortly.

MR. HANSEN: We'll get them as soon as we can. We would also ask for copies of your Exhibits 1, 2, 3, and also the copies of --

MR. CARTER: I think I was going to do that, wasn't I?

MR. SMITH: That was the --

MR. HANSEN: And also a copy of the document that Mr. Leemaster was just referring to.

MR. CARTER: All right. Is that acceptable, just your test results with regard to the spring quality?

THE WITNESS: I don't see any problem providing that.

MR. CARTER: With that, we'll close.

MR. SMITH: Why don't we make those an exhibit, then, if we're going to be providing it to the other side?

MR. CARTER: If I can find out what number that would be --

(A discussion was held off the record.)

MR. CARTER: We'll make those an exhibit.

MR. HANSEN: It's fine with me to stipulate that it may be an exhibit and the water users may determine what the next sequential exhibit number is and give it that number.

MR. CARTER: And with that, we'll close. And drive carefully.

(Proceedings adjourned at 6:15 p.m.)

C E R T I F I C A T E

State of Utah)
: ss.
County of Emery)

THIS IS TO CERTIFY that the foregoing proceedings were taken before me, SCOTT M. KNIGHT, a Registered Professional Reporter and Notary Public in and for the State of Utah, residing at West Jordan, Utah;

That said proceedings were reported by me in Stenotype and thereafter caused by me to be transcribed into typewriting and that a full, true, and correct transcription of said proceedings so taken and transcribed is set forth in the foregoing pages numbered from 4 to 303, inclusive.

I further certify that I am not of kin or otherwise associated with any of the parties to said cause of action, and that I am not interested in the event thereof.

WITNESS MY HAND and official seal at West Jordan, Utah, this 26th day of March, 1997.

NOTARY PUBLIC
SCOTT M. KNIGHT
8358 So. Water Pointe Dr.
West Jordan, UT 84088
My Commission Expires
June 19, 2000
STATE OF UTAH

Scott M. Knight, RPR
Utah License No. 92-110171-7801

My Commission Expires:
June 19, 2000